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MOSS FLORA

ECJ
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OF

NORTH AMERICA

North of Mexico

BY

A. J. GROUT, PH.D.

FELLOW AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE; MEMBER BOTANICAL SOCIETY OF AMERICA; FOUNDER AND ASSOCIATE EDITOR OF THE BRYOLOGIST; MEMBER ALL YEAR STAFF, BIOLOGICAL LABORATORY, COLD SPRING HARBOR, L. I., N. Y.

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KEY TO FAMILIES AND SOME GENERA OF THE MUSCI OF NORTH AMERICA

The making of a general key to the genera and families of the Moss Flora of North America is a very complicated matter. A perfect key is impossible because of variations in the characters of not only species but also genera and families.

Gametophyte characters are used wherever possible, to facilitate the identification of sterile specimens.

a. Plants whitish or light gray-green, especially when dry	b.
Plants green, yellow-green, or dark green to almost black	c.
b. Plants of bogs; leaves of large colorless cells (usually with spiral thickenings) surrounded by narrow green cells	SPHAGNACEAE.
Leaves 2 or more layers of cells in thickness	LEUCOBRYACEAE.
c. Acrocarpous (usually easily determined even in sterile specimens)	e.
Pleurocarpous	F.
e. Leaves in two ranks or strongly complanate	A.
Leaves in at least three rows, not complanate	d.
d. Plants black or blackish-green except at the ends of growing stems and branches, growing on trees and rocks; leaves with thick cell walls	f.
Plants green to light yellow-green, sometimes hoary from the hyaline leaf apices; if blackish, growing on the ground	C.
f. Leaves ecostate	g.
Leaves costate	B.
g. Leaves obtuse, never with hyaline apices	*Andreaea.*
Leaves acute, mostly with hyaline apices	*Hedwigieae.*

A.

1. Leaves truly distichous in two rows on the stems	2.
Leaves complanate, not truly distichous	*Mnium.*
2. Leaves ecostate (see *Fissidens*); confluent at their bases in sterile plants	*Schistostega.*
Leaves with a single costa, not confluent	3.
3. Leaves very narrow, subulate-setaceous	*Distichium.*
Leaves lanceolate or broader, with double, sheathing laminae at base	FISSIDENTACEAE.

B.

1. Leaves with a hyaline apex	2.
Leaves without hyaline apex	4.
2. Basal leaf cells linear-nodose, very thick-walled	*Rhacomitrium.*
Basal leaf cells not linear-nodose, often thinner-walled than the upper	3.
3. Leaves mostly smooth; plants growing on rocks	GRIMMIACEAE.
Leaves mostly papillose; plants growing on trees	ORTHOTRICHACEAE.
4. Basal leaf cells linear-nodose, very thick-walled	*Rhacomitrium.*
Basal leaf cells not as above	5.
5. Leaves crispate when dry	6.
Leaves not cripsate when dry, often somewhat contorted	7.
6. Growing on trees	ORTHOTRICHACEAE.
Growing on rocks	GRIMMIACEAE.

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7. Plants very brittle; capsule splitting into 4 or more valves; mostly alpine or subalpine	*Andreaea.*
Plants less brittle, many species common; capsule operculate	8.
8. Leaves usually papillose; peristome double, rarely single or lacking	ORTHOTRICHACEAE.
Leaves usually not papillose; peristome single, rarely lacking	GRIMMIACEAE.

C.

1. Leaves with numerous lamellae on inner surface of costa (inconspicuous in *Atrichum crispum*)	2.
Leaves without such lamellae	3.
2. Plants very small, rare; leaves ovate	*Pterygoneurum.*
Plants large; leaves lanceolate to oblong	POLYTRICHACEAE.
3. Stalked receptacles bearing gemmae nearly always present	4.
Gemmae, if present, borne on leaves and stems	5.
4. Gemmae in terminal leafy cups	*Tetraphis.*
Gemmae in rounded heads on terminal stalks	*Aulacomnium.*
5. Plants minute, almost microscopic, mostly annual	EPHEMERACEAE, *Phascum.*
Plants larger, easily seen without a lens	6.
6. Leaf cells papillose	D.
Leaf cells not papillose	E.

D.

1. Cells of sheathing base of leaves large, hyaline and smooth; upper cells small, usually papillose and obscure	CALYMPERACEAE.[1]
Leaf bases not sheathing or if sheathing, less strongly differentiated	2.
2. Leaves strongly contorted to crispate when dry	3.
Leaves little or not at all contorted when dry	10.
3. Papillae at or near the cell angles	BARTRAMIACEAE.
Papillae over the cell lumen, more or less central	4.
4. Leaves spatulate to lingulate, obtuse; costa often excurrent	5.
Leaves mostly lanceolate to oblong, obtusely acute to slenderly acuminate	7.
5. Perichaetial leaves ciliate; capsules nearly sessile, ovoid, strongly inclined; peristome a whitish cone	*Diphyscium.*[2]
Not as above	6.
6. Calyptra very large, extending below the large capsule	*Encalypta.*
Calyptra not reaching capsule base	POTTIACEAE.
7. Alar cells distinctly enlarged and inflated	DICRANACEAE.
Alar and basal cells often somewhat larger and hyaline, but alar not distinctly inflated	8.
8. Leaves entire or slightly denticulate above	9.
Leaves strongly serrate	*Timmia.*
9. Capsules striate when dry; peristome dicranoid	*Oncophorus.*
Capsules rarely striate; peristome usually of 16 teeth divided nearly to base into 2 filiform segments, sometimes irregular or lacking	*Trichostomeae.*
10. Leaves obtuse, broadly ovate to oblong-ovate	*Aulacomnium.*
Leaves acute to acuminate	11.
11. Leaves squarrose-recurved	*Paludella.*
Leaves loosely spreading to imbricate	BARTRAMIACEAE.

[1] *Timmia* may be sought here.

[2] *Buxbaumia* has capsules like *Diphyscium* but all the leaves are ciliate and disappear before the spores are ripe.

E.

1. Alar cells plainly inflated, often colored	*Blindia*, DICRANACEAE.
Alar cells not distinctly inflated, sometimes larger and hyaline	2.
2. Leaves more or less bordered by narrow elongated cells	3.
Leaves not so bordered	5.
3. Leaves indistinctly bordered	*Mnium.*
Leaves distinctly bordered	4.
4. Leaf cells nearly or quite as broad as long, leaves broad	MNIACEAE.
Leaf cells usually much longer than broad	BRYACEAE.
5. Upper leaf cells 20 μ or more in diameter	6.
Upper leaf cells small or narrower, rarely over 15 μ wide	10.
6. Leaf cells short, quadrate or rounded	7.
Leaf cells much longer than broad	8.
7. Costa excurrent	*Pottia.*
Costa ending below apex	*Mnium.*
8. Leaf cells with pointed ends	BRYACEAE.
Leaf cells flattened at the ends or leaves large, wide and flaccid	9.
9. Capsules with a marked hypophysis, often larger than the capsule proper	SPLACHNACEAE.
Capsules without hypophysis	*Amblyodon*, FUNARIACEAE.
10. Leaves relatively short, glaucous with a mealy bloom	*Saelania.*
Leaves not glaucous	11.
11. Capsules with a prominent neck up to 1/3 capsule length	16.
Capsules without prominent neck	12.
12. Plants small, rarely collected when sterile	13.
Plants 1–3 cm. high or larger	18.
13. Plants rare, alpine or growing in cool shaded elevated regions	SELIGERIACEAE, DICRANACEAE.
Plants of lower altitudes and more frequent occurrence	14.
14. Spores 250–500 μ in diameter	*Archidium.*
Spores less than 50 μ in diameter	15.
15. Capsules on a long seta, operculate and with a peristome	*Dicranella.*
Capsules sessile or nearly so	*Bruchia, Pleuridium.*
16. Capsules mostly sessile and cleistocarpous; peristome never present; plants under 1 cm. high	*Bruchia.*
Capsules on a long seta, operculate and with peristome	17.
17. Neck as long as the capsule proper or longer	*Leptobryum, Trematodon.*
Neck shorter than the capsule proper, peristome double	*Meesea.*
18. Leaves squarrose-spreading	*Dicranella.*
Leaves not squarrose	19.
19. Peristome double	*Rhizogonium, Timmia.*
Peristome single	20.
20. Peristome teeth forked to a little below the middle, usually longitudinally striate	*Dicranella.*
Peristome teeth divided nearly or quite to base or perforate nearly to base	DITRICHACEAE and *Didymodon.*

F.

1. Leaves papillose	2.
Leaves not papillose	15.
2. Papillae formed by projecting cell angles	HYPNACEAE and *Pterogonium.*
Papillae over cell lumen	3.
3. Leaves with a strong spreading double costa reaching beyond middle of leaf	*Callicostella.*
Costa single, or short, or lacking	4.

4. Costa short, often faint and double or lacking ..... 5.
   Costa well developed, mostly single and reaching leaf middle ..... 6.
5. Leaf cells rarely over 3 : 1, often shorter ..... LESKEACEAE and *Schwetschkeopsis.*
   Leaf cells more than 3 : 1 ..... *Taxithelium.*
6. Leaf cells with a single papilla at back ..... 7.
   Leaf cells with two or more papillae at back on some or all ..... 11.
7. Papillae very large and sharp ..... 8.
   Papillae relatively low and small ..... 9.
8. Plants large, dendroid, circinate when dry, dark green ..... *Dendroalsia.*
   Plants smaller, light green to glaucous ..... *Thelia, Myurella, Lindbergia, Thuidium* sp.
9. Leaves somewhat complanate; plants subtropical ..... *Stereophyllum.*
   Leaves not at all complanate ..... 10.
10. Capsules immersed ..... *Cryphaea.*
    Capsules on a long seta ..... LESKEACEAE.
11. Leaves strongly auriculate ..... 12.
    Leaves not auriculate ..... 13.
12. Auricles fimbriate-papillose ..... *Anomodon Rugelii.*
    Auricles scarcely papillose ..... *Tricholepis.*
13. Leaf cells less than 5 : 1, mostly dense and subopaque ..... LESKEACEAE.
    Leaf cells more than 5 : 1, not dense or opaque ..... 14.
14. Margins plane ..... *Barbella.*
    Margins revolute ..... *Leucodontopsis.*
15. Costa strong, single, reaching leaf middle or beyond ..... 16.
    Costa not as above ..... 30.
16. Leaves strongly complanate ..... 17.
    Leaves not complanate ..... 18.
17. Plants with small differentiated dorsal or ventral leaves ..... *Hypopterygium, Rhacopilum.*
    Plants without such leaves ..... *Porothamnium* and NECKERACEAE.
18. Leaves squarrose-spreading ..... 19.
    Leaves not squarrose-spreading ..... 22.
19. Plants found in our range in Florida only ..... 20.
    Plants rarely if ever found in the Gulf States ..... 21.
20. Leaf cells strongly porose; brood bodies often found in leaf axils ..... *Jaegerinopsis.*
    Leaf cells not porose; brood bodies unknown ..... *Meteoriopsis.*
21. Plants slender; paraphyllia lacking ..... *Campylium.*
    Plants robust; paraphyllia generally present ..... *Hylocomieae.*
22. Median leaf cells 4 : 1 or less ..... 23.
    Median leaf cells 5–20 : 1 ..... 28.
23. Plants the smallest of the pleurocarpi; leaves soft and delicate; costa thin, often not reaching leaf middle ..... FABRONIACEAE.
    Plants small to large; leaves more rigid; leaf cells thicker-walled ..... 24.
24. Costa strong, nearly reaching apex, markedly flexuous ..... *Herpetineuron.*
    Costa various but not flexuous ..... 25.
25. Capsules exserted on a long seta ..... 26.
    Capsules on a short seta, immersed to shortly exserted ..... 27.
26. Paraphyllia usually present, often abundant ..... LESKEACEAE.
    Paraphyllia lacking or sparse ..... HYPNACEAE.
27. Inner peristome usually present ..... CRYPHAEACEAE.
    Inner peristome rudimentary or lacking ..... LEUCODONTACEAE.
28. Plants rarely fruiting, confined to Florida and the Gulf coast ..... *Pireella* and *Pseudocryphaea.*
    Plants found in all parts of North America ..... 29.
29. Aquatic; perichaetial leaves nearly or quite as long as the seta ..... FONTINALACEAE.
    Not aquatic; seta much longer than the perichaetial leaves ..... HYPNACEAE.
30. Costa double and strong, reaching the middle or beyond ..... HOOKERIACEAE; HYPNACEAE
    Costa short to lacking ..... 31.

31.	Leaves strongly complanate	32.
	Leaves not complanate	34.
32.	Leaves soft and thin; leaf cells 50–60 μ wide	*Hookeria*.
	Leaves of firmer texture, cells much narrower	33.
33.	Capsules on a long seta	*Homalia* and HYPNACEAE.
	Capsules on a short seta, immersed to emergent	*Neckera*.
34.	Aquatic, long and floating, capsules immersed	FONTINALACEAE.
	Rarely aquatic, if so only a few centimeters long	35.
35.	Capsules exserted on a long seta	HYPNACEAE.
	Capsules immersed	*Leptodon*.

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ANDREAEACEAE

BY

A. J. SHARP

ARCHIDIACEAE

BY

STANLEY A. CAIN, PH.D.

VOLUME I

Part 1

PUBLISHED BY THE AUTHOR

NEWFANE, VERMONT

OCTOBER, 1936

Order ANDREAEALES.*

A. J. Sharp.†

Plants relatively small, dark, growing in tufts or cushions on non-calcareous rocks of mountainous or frigid regions. Stems slender, radiculose only at the base, dichotomous, or with fasciculate branches. Central strand none; stem composed of stereid-cells with uniformly and densely thickened cell-walls. Leaves relatively small, frequently crowded, papillose or smooth, costate or ecostate, ovate to subulate, olive- to reddish-brown. Leaf cells small, obscure, incrassate, rectangular and sometimes sinuose at base, angular or rounded above.

Monoicous or dioicous; antheridia usually in gemmiform buds, on separate branches. Perichaetial leaves larger, erect, convolute, or scarcely differentiated from the stem-leaves. Sporophyte dark, small, without a seta but shortly exserted at maturity on a pseudopodium. Capsule ovate-oblong, without intercellular air spaces, opening at maturity usually by means of 4 (sometimes as many as 10) longitudinal slits which do not converge at apex and are closed when moist and widely gaping when dry. Columella thick, persistent. Spores 15–40 μ, smooth or slightly roughened, dark, thick-walled. Calyptra campanulate, mitriform, fugacious, lacerate at the base.

Protonema normally thallose, starting its development inside the spore.

The order is represented by one family, *Andreaeaceae*, and in North America by one genus, *Andreaea*

ANDREAEA Hedw. Spec. Musc. 47. 1801.

The genus has characters as stated for the order.

Key.

1.	Leaves ecostate	2.
	Leaves costate	3.
2.	Leaves distinctly panduriform	2. *obovata.*
	Leaves not panduriform	1. *rupestris.*
3.	Perichaetial leaves similar to stem leaves; upper margin serrate and papillose	5. *nivalis.*
	Perichaetial leaves much larger and more convolute than stem leaves; upper margin usually neither distinctly serrate nor papillose	4.
4.	Costa flat and often weak at the base of the leaf	3. *Blyttii.*
	Costa thick and strong at the base of the leaf	4. *Rothii.*

1. Andreaea rupestris Hedw. Sp. Musc. 47. *pl. 7. fig. 2*, exclud. syn. 1801.

Andreaea petrophila Ehrh. Beitr. **1**: 192. 1787.

Plants crowded in dark-green, reddish-brown or black cushions; stems 1–3 cm. long (occasionally longer), rigid when dry, simple or dichotomous; leaves crowded, *ecostate*, extremely variable in shape, direction and texture, usually asymmetric, *not panduriform*, concave, ovate to almost lanceolate, muticous or slightly apiculate, nearly smooth to strongly papillose on the back, when moist spreading from an erect base, *laxly appressed when dry*, 0.7–1.5 mm. long, 0.2–0.7 mm. wide; margin entire and incurved; apex often hyaline and crenulate; basal cells oblong with linear often irregular lumen, smooth; median cells shorter; cells of the upper third of the leaf punctiform; perichaetial leaves larger, softer, erect and convolute, often more blunt and paler, inner smooth, outer papillose, 1–3 mm. long. Monoicous; pseudopodium immersed

Limp. I 39, 40
" I 39

* Contributions from the Botanical Laboratory, The University of Tennessee, N. Ser.

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or slightly exserted; capsule small, pale below, reddish-brown above; spores brown, 20–30 μ, ovoid, often slightly roughened, maturing in summer.

Type locality, Europe.

ILLUSTRATIONS:—Hedw. Sp. Musc. l. c.; Bry. Eur. *pl. 623–626;* Braithw., Brit. Moss Flora **1:** *pl 1A;* Dixon & Jameson, Hdbk. Brit. Mosses, (Ed. 3) *pl. 4A;* M. H. M. *pl. 6.*

EXSICCATI:—Drummond, Musci Am. 1; Sull. Musci Allegh. 215. Sull. & Lesq. Musci Bor. Am. 18, (Ed. 2) 24; Aust. Musci Appal. 42; Holz. Musci Acro. Bor. Am. 226; R. & C. Musci Am. Sept. 201; Grout, N. Am. Musci Perf. 183.

Common on moist non-calcareous rocks in mountainous or colder regions. Alaska to Greenland, south along the mountains, in the east to Georgia, in the west to California and Colorado; Newfoundland.

This is a most variable species, a fact which accounts for the large number of untenable species which have been described from material here included in this species and its varieties.

Var. ALPESTRIS Thed. Nya. Bot. Not. **1849:** 79. *fig. 45–47.* 1849.

Andreaea alpestris (Thed.) Bry. Eur. (fasc. 62–64) Andr. 16. *pl. 626.* 1855.
Andreaea parvifolia C. Müll. Flora **70:** 219. 1887.

This variety differs from *A. rupestris* in the *crowded, smaller leaves which are closely appressed when dry.* The cells are generally broader, the walls less pitted and not so papillose.

Type locality: Switzerland.

ILLUSTRATIONS:—Thed. l. c.; Bry. Eur. *pl. 626;* Braithw. Brit. Moss Flora **1:** *pl. 1C.*
EXSICCATI:—Holz. Musci Acro. Bor. Am. 276.
On non-calcareous rocks. Greenland south to New York; Alaska south to Montana and Washington.

Var. ACUMINATA Bry. Eur. (fasc. 62–64) Andr. 13. *pl. 624.* 1855.

Andreaea sublaevis Kindb. Eur. & N. Am. Bryin. 393. 1897.
Andreaea papillosa Lindb. Oefv. Sv. Vet.-Akad. Forh. **23:** 557. 1867.

This variety differs from the species in that it is *usually larger, with longer,* acuminate leaves and *usually larger papillae.*

Type locality, Europe.

ILLUSTRATIONS:—Bry. Eur. l. c.; Braithw. Brit. Moss Flora **1:** *pl. 1A γ; Pl. 1A.*
EXSICCATI:—Williams, Plants of Yukon Terr. 523.
Rare; on non-calcareous rocks. Greenland, Yukon Territory.
The type of *A. papillosa* has not been seen, but there is nothing in the description to distinguish it from the variety *acuminata.*
Kindberg's *A. sublaevis* is much like *acuminata* but is not so papillose. Williams' plants are not as papillose as the above description indicates.

Var. SPARSIFOLIA (Zett.) Lindb. Spitz. Moss. 559. 1867.

Andreaea sparsifolia Zett. Monogr. Andr. 32. 1855.

Plants in small open tufts; stems very slender with few branches; *leaves small, distant, spreading, gradually acuminate,* with small papillae.

Type locality, Scandinavia.

ILLUSTRATIONS:—Limpricht, Laubm. **1:** *fig. 53;* Braithw. Brit. Moss Flora **1:** *pl. 1.*
A single collection by Waghorne in Newfoundland seems referable to this variety.

2. ANDREAEA OBOVATA Thed. Bot. Notiser **1849:** 78. *fig. 27–36.* 1849.

Similar to *A. rupestris,* but with *symmetric, broadly ovate, panduriform leaves (clasping at the base), which are either mammillose or papillose at back with low brown papillae.*

Type locality, Sneehätten, Dovrefjeld, Norway.

ILLUSTRATIONS:—Thed. l. c.; Bry. Eur. *pl. 627; Pl. 2B.*
EXSICCATI:—Berggren, Plantae in itineribus Suecorum polaribus collectae. Ritenbank. 1870.
On rocks. Greenland.

It is obvious that *A. obovata* is related to *A. rupestris*, but the broad, symmetric, panduriform leaves serve to distinguish the former from the latter.

3. ANDREAEA BLYTTII Bry. Eur. (fasc. 62–64) Andr. 25. *pl. 635.* 1855.

Andreaea perichaetialis Zett. Monogr. Andr. 26. 1855.

Plants brown or black in low colonies; stems 1–2 cm. high, rigid and brittle; branches slender, subapical; leaves spreading, often slightly secund at the apex, lanceolate to lanceolate-subulate, 1–2 mm. long, with a short oblong base which rapidly narrows into a subula above; *costa flat and weak below, stronger above but not conspicuous;* basal cells oblong, not sinuose or porose; those above, round or square, distinct, with thick walls, often mammillose but *never strongly papillose;* perichaetial leaves larger, 1–2.5 mm., concave, convolute, the inner ones ecostate. *Dioicous;* the male plants more slender; *sporophyte small;* capsule dark, 0.75 mm. in diameter, ovate-conic, apiculate; spores small, 11–14 μ, brown, smooth, maturing in summer.

ILLUSTRATIONS:—Bry. Eur. l. c.; *Pl. 1B.*

On rocks. Greenland, Davis Straits, Arctic America, Washington (Olympic Mts.), California.

In the herbarium of the New York Botanical Garden, there is a collection from California by Bolander which is certainly referable to this species. Its distribution is noteworthy as it has been collected but once between Alaska and California!

There is no need to confuse this plant with *A. Rothii* var. *crassinervia* since the latter exhibits a costa which is distinct and thickened to the base of the leaf.

Var. OBTUSIFOLIA (Berggr.) Sharp, **comb. nov.**

Andreaea obtusifolia Berggr.; G. Roth, Aussereur. Laubm. **1:** 72. *pl. 7. f. 6a.* 1910. Not *A. obtusifolia* T. Jens.

This variety differs from *A. Blyttii* in the *broader, more obtuse leaves,* and in exhibiting a *costa which is often lacking in the base of the leaf and weak above.*

ILLUSTRATIONS:—G. Roth, l. c.

Rare; on rocks. Greenland.

4. ANDREAEA ROTHII Web. & Mohr. Bot. Tasch. 386. *pl. 11. fig. 7–9.* 1807.

Andreaea rupestris Roth, Neue Beytr. **1:** 234. 1802, exclud. syn.
Andreaea rupestris Turn. Musc. Hibern. 14. 1804.

Plants small, black, occasionally brown; stems dichotomous or fastigiate, 1–2.5 cm. long, often denuded at the base; leaves slender, 0.8–1 mm. long, spreading or secund, often falcate, from an ovate or oblong base gradually or suddenly contracted into a long, lanceolate-acuminate point; margin entire or crenate; *costa strong, prominent* and often rough at back, subpercurrent or percurrent; basal cells near the margin quadrate, near the middle linear-oblong *with small irregular lumen;* upper cells small, punctiform, their walls thick and often mammillose; perichaetial leaves larger, oblong with an acuminate point, 1.5–2 mm. long, the outer costate and occasionally papillose above, the inner ecostate. Monoicous; capsule oblong-ovate, dark, pale at base, 0.75 mm. long; spores large, 30–40 μ, very slightly roughened, maturing in summer.

Type locality, Mt. Snowden, Wales.

ILLUSTRATIONS:—Web. & Mohr., l. c.; Bry. Eur. *pl. 631;* Braithw. Brit. Moss Flora **1:** *pl. 2A;* Limpricht, Laubm. **1:** *fig. 56;* Dixon & Jameson, Hdbk. Brit. Mosses (Ed. 3) *pl. 4C;* M. H. M. *fig. 11.*

EXSICCATI:—Sull. Musci Allegh. 214; Sull. & Lesq. Musci Bor. Am. 19, (Ed. 2) 25; Aust. Musci Appal. 43; Holz. Musci Acro. Bor. Am. 302; Grout, N. A. Musci Perf. 294 (as *A. rupestris* Hedw.).

On non-calcareous rocks. Greenland and Newfoundland to the Upper Peninsula of Michigan and south along the mountains to Georgia and Alabama; rare in British Columbia and northwestern U. S.

Var. FALCATA (Bry. Eur.) Lindb. in lit., Braithw. Brit. Moss Flora **1:** 14. *pl. 2.* 1880.

Andreaea falcata Bry. Eur. Andr. 24. *pl. 624.* 1855.

Plants with *leaves falcate* and *erose-dentate near the apex.* Type locality, Europe.

ILLUSTRATIONS:—Braithw. l. c.; Bry. Eur. l. c.
EXSICCATI:—Macoun, Vancouver Island, May 19, 1893.
Extremely rare. British Columbia.

Var. CRASSINERVIA (Bruch) Mönkem. Laubm. Eur. **4**: 129. 1927.

Andreaea crassinervia Bruch, Abh. Akad. Münch. **1**: 279. *pl. 10.* 1832.

Costa *distinctly excurrent; basal cells seldom with irregular lumen;* otherwise very similar to *A. Rothii*. Type locality, Grimsel, Switzerland.

ILLUSTRATIONS:—Bruch, l. c.; Bry. Eur. *pl. 633;* Braithw. Brit. Moss Flora **1**: *pl. 1C;* Limpricht, Laubm. **1**: *fig. 54;* Dixon & Jameson, Hdbk. Brit. Mosses (Ed. 3) *pl. 4D;* M. H. M. *fig. 12.*
EXSICCATI:—Holzinger, Musci Acro. Bor. Am. 301; Small, Mosses of South. U. S. 27.
Rare; on rocks. Mountains of eastern North America; Labrador to Georgia.
Much of the material labeled *A. crassinervia* in herbaria is *A. Rothii*. Leaves with narrow laminae or with eroded margins bear the appearance of having excurrent costae, a condition which contributes to the confusion. Occasional collections are found with both subpercurrent and excurrent costae in the leaves and all intergradations between. There is no character at present discovered which will separate them in all cases.

5. ANDREAEA NIVALIS Hook. Trans. Linn. Soc. **10**: 395. *pl. 31.* 1811.

Andreaea nivalis var. *fuscescens* Hook. l. c.
Andreaea Macounii Kindb.; Macoun, Bull. Torr. Bot. Club **17**: 83. 1890.
Andreaea Baileyi Holz. Bryol. **27**: 78. 1924.

Plants the largest of the North American *Andreaeae*, *not harsh or brittle*, reddish-brown or darker but *not black;* stems slender, 4–10 cm. long, erect or trailing, with few dichotomous branches which are subapical, flexuose and secund at tips; leaves soft, rather distant, secund, 1–1.5 mm. long, the lower smaller, wider, the upper longer and more slender, from an oblong base gradually narrowed; costa strong, percurrent or obscure in the rough subulate tip, *dentate or papillose on the back; margins sinuose-dentate and papillose* (occasionally entire) *above, generally irregularly dentate below; cells rounded or square, similar throughout, seldom opaque, papillose on both sides; perichaetial leaves similar to those of the stem* except in size, 2–2.5 mm. long. Dioicous; sporophyte rare; capsule brown, about 1 mm. long, oblong, slightly exserted, *with 6* (rarely 4) *slits;* calyptra very small, conic; spores essentially smooth, 20–25 μ, maturing in summer.

Type locality, Ben Nevis, Scotland.

ILLUSTRATIONS:—Hook. l. c.; Bry. Eur. *pl. 636;* Braithw. Brit. Moss Flora **1**: *pl. 2B;* Dixon & Jameson, Hdbk. Brit. Mosses (Ed. 3) *pl. 4E; Pl. 2A.*
EXSICCATI:—Macoun, Can. Musci 34 & 401; Holzinger, Musci Acro. Bor. Am. 501 as *A. nivalis Baileyi.*
On moist alpine rocks near the glaciers. Washington, Oregon, British Columbia.
This, the largest of the North American *Andreaea* species, may be recognized by its size, softness, the peculiar fulvous tint, the distinctness of the uniform, unelongated cells, and the undifferentiated perichaetial leaves when they are present.
Although the species, *A. Macounii* and *A. Baileyi*, and the variety, *fuscescens*, sometimes appear distinct, more extensive collections show intergradations with *A. nivalis*. There are not enough reliable distinctions to warrant separating them.

Order BRYALES.

The mosses of this order vary much in detail. With few exceptions they spring from a filamentous protonema; the outer wall of the archegonium after some growth is ruptured, the lower portion forming the vaginula and the upper, the calyptra. The lower part of the embryo forms the seta, which may be exceedingly short or reach a length of several centimeters, the upper part becomes the capsule; the endothecium gives rise to the spore-producing tissue, which surrounds an inner sterile tissue; this becomes the columella in all the species except *Archidium*, but not apparent in the *Ephemeraceae*. The capsules may dehisce irregularly, but most open by an evenly dehiscent lid or operculum, usually separating from the rest of the capsule by the aid of a special row or rows of cells, the annulus. In the great majority of the species there is produced from the layers of cells immediately under the lid a complex structure, the peristome, which is strongly hygroscopic and whose function is to control spore distribution. The peristome is often beautifully sculptured and colored and a delight to the eye of the microscopist. Below the spore sac

many capsules have a more less apparent neck or collum in which are stomata of various degrees of perfection and considerable assimilative tissue.

Family TETRAPHIDACEAE.

Plants minute to medium sized, gregarious to cespitose; stems erect, simple or sparingly branched; leaves unistratose, ovate to lanceolate, smooth; costa present, usually well developed and ending just below the leaf apex; leaf cells parenchymatous, rounded-hexagonal to elongate, thick-walled; perichaetial leaves longer and narrower. Autoicous; inflorescence apical; seta long, straight or geniculate near the middle; capsule erect and symmetric or rarely slightly arcuate, smooth, ovoid to cylindric; calyptra mitriform, plicate; annulus lacking; operculum conic, unistratose, of epidermal cells only; peristome teeth 4, solid, derived from the splitting of the entire cell mass within the operculum, homogeneous, not segmented, open when dry, closed when wet.

A very small family of four or five species, considered primitive by reason of the peristome structure and peculiar frondiform growths from the protonema.

TETRAPHIS Hedw. Sp. Musc. 45. 1801.

Georgia Ehrh. Han. Mag. **1780.** 932. 1780.

Characters as in the family. Dixon's opinion (Handb. Brit. Mosses (Ed. 3) 30, is heartily endorsed. "Braithwaite is no doubt right in reuniting the two European species under this genus, the characters separating *Tetrodontium* being hardly of generic value.

The genus is easily recognized in the field by the 4-toothed peristome, which is usually present, as the plants fruit freely and capsules and peristome are long persistent. Type species, *T. pellucida*.

Key.

1. Plants almost stemless; costa faint; calyptra covering the entire capsule; no gemmiferous plants ..... *3. Browniana.*
   Stems 1–3 cm. long; costa strong, ending near the apex; calyptra covering not more than ½ the capsule; gemmiferous plants usually present ..... 2.
2. Seta smooth, not noticeably geniculate ..... *1. pellucida.*
   Seta geniculate and tuberculate above the bend ..... *2. geniculata.*

1. Tetraphis pellucida Hedw. Sp. Musc. 45. *pl. 7, f. 1, a–f.* 1801.

Mnium pellucidum of Linnaeus and many authors before 1801.
Georgia pellucida Rabenh. Deutsch. Krypt. Fl. **2**[3]: 231. 1848.

Plants densely to loosely cespitose; stems erect, 1–3 cm. long, radiculose at base; lower leaves minute, the upper larger, closer at the top of the stem, ovate to ovate-lanceolate from a narrower base, mostly acute; perichaetial leaves, longer and narrower, oblong-lanceolate, up to 4 mm. long, obtuse to obtusely acute; all entire; many sterile stems bear at the summit a cup composed of short leaves, broadly obovate to reniform, truncate to apiculate; inside the cup many stalked gemmae, lenticular and many celled,mixed-with numerous paraphyses; costa strong, ending below the apex, or in perichaetial leaves sometim es per current; leaf cells rounded, nearly isodiametric, variable in outline, 8–20 μ in diameter in the upper middle leaf, smaller near the margins, elongated toward the base, especially near the costa and in the lower portion of the perichaetial leaves. Seta straight and erect, 1–1.5 cm. long, smooth; capsule narrowly cylindrical, erect and symmetric or occasionally slightly arcuate, 2–2.5 mm. long, persistent; stomata lacking; calyptra rough at the apex; operculum acutely conical; peristome teeth narrowly triangular, composed of elongated cells; spores 8–12 μ, mature in spring to early summer.

Type locality, European.

Illustrations:—Hedw. l. c.; Bry. Eur. *pl. 196;* Braithw. Brit. Moss. Fl. **1**: *pl. 4A;* M. H. M. *figs. 3 & 13; Pl. 3.*

Exsiccati:—Drumm. Musc. Am. 31; Sull. Musc. Allegh. 154; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 110, (Ed. 2) 164; Aust. Musc. Appal. 173; Holz. Musc. Acro. Bor. Am. 67; Grout, Musci Perf. 56; Allen, Mosses Cascade Mts. 47.

On humus and decaying wood in cool moist, shaded places; common and widely distributed in northern N. America across the continent; south to Georgia, Tennessee, Missouri and California.

1a. Forma CUSPIDATA (Kindb.) **n. comb.**

Georgia cuspidata Kindb. Rev. Bryol. **20**: 93. 1893.

Perichaetial leaves cuspidate by the excurrent costa ("nervure longuement excurrente") Leamington, Canada, Sept. 22, 1890 (Macoun); Ohio (Schrader).

In specimens in the National Museum of Canada from the type locality and collected by Macoun on Sept. 20 instead of 22, the perichaetial leaves are very slender-pointed but the costa is barely or not at all excurrent. This variation is certainly not worthy of rank above a form.

2. TETRAPHIS GENICULATA Girgens., Milde, Bot. Zeit. **3**: 155. 1863.

Georgia geniculata Lindb. Cont. ad Fl. Asi. Bor. Or. **1872**: 239. 1872.
Georgia trachypoda Kindb. Rev. Bryol. **20**: 93. 1893.

Differs from *T. pellucida* in the longer and narrower upper leaves, more slender-pointed; perichaetial leaves acute; seta usually bent in the middle and always rough above the bend with large distant papillae or tubercles.

Type locality, Japan.

ILLUSTRATIONS:—Bry. Eur. Suppl. Tetraphis, *pl. 1; Pl. 4B.*
EXSICCATI:—Holz. Musc. Acro. Bor. Am. 343; Macoun, Can. Musci 422.
Northern N. America; south to Oregon, Idaho and Nova Scotia. Habitat similar to that of the last.

Not materially different in macroscopic appearance from *T. pellucida*, as the seta is not always noticeably bent at first glance and the bend is sometimes absent as in Kindberg's *Georgia trachypoda* (the only difference of importance that he notes in his description). The roughness of the upper seta in this species is a distinct character, but a relatively high power is needed to see it.

Specimens in the herbarium of the National Museum of Canada, labeled *Georgia trachypoda* and collected at same date and place as the type and probably a part of it, have the seta only slightly roughened and not geniculate, otherwise normal.

3. TETRAPHIS BROWNIANA (Dicks.) Grev. Flor. Edinb. 230. 1824.

Bryum Brownianum Dicks. Pl. Crypt. fasc. **4**: 7. *pl. 10.* 1801.
Tetraphis ovata Schwaegr. Suppl. **1**: 39. *pl. 13.* 1811.
Georgia Browniana C. Muell. Syn. **1**: 181. 1848.
Tetrodontium Brownianum Schwaegr. Suppl. **2**[1]: 102. *pl. 129.* 1824.

Plants very small, about the size of a *Seligeria;* stems almost wanting; radical frondiform leaves 2–3 stratose, persistent, long linear-clavate, sometimes palmately branched at the upper end; among these a perichaetial bud of 8–12 leaves is produced; of these the lower or outer are very small and ecostate, all are ovate to oblong-lanceolate, concave, obtuse to acute, entire or finely crenulate above; the upper over 1 mm. long and costate to above the middle; median leaf cells rhomboidal to rectangular, larger and laxer toward the base, shorter and more irregular near the apex. Seta 4–6 mm. long, straight and erect; calyptra covering the entire capsule, not rough at apex; capsule erect and symmetric, ovoid to oblong-ovoid; urn together with the short neck a little over 1 mm. long; operculum conic; circular stomata sometimes present near the base of the spore sac; peristome teeth broadly triangular; spores reaching 15 μ, mature in summer.

Type locality, Scotland.

ILLUSTRATIONS:—Schwaegr. l. c.; Bry. Eur. *pl. 197;* Braithw. l. c. *B*; *Pl. 3.*
Rare; on sandstone or granitic rock; sometimes found inverted from the roof of caves or clefts; cool shaded places in elevated or northern regions. Newfoundland; Maine; in a cave near the summit of Mount Prospect, Holderness, New Hampshire (Grout); Wilmington Notch, N. Y. (Mrs. Britton).

3a. Var. REPANDA Funck in Sturm, Deutschl. Fl. **2**: heft. 17, plate. 1819.

Tetraphis repanda Schwaegr. Suppl. **2**[1]: 21. *pl. 107.* 1824.
Tetrodontium repandum Schwaegr. l. c. 102.
Georgia repanda C. Muell. Syn. **1**: 181. 1848.

Differs from the species in practically nothing but that the frondiform leaves are replaced by slender flagelliform shoots bearing minute ovate-lanceolate leaves. These become attached to the substratum and produce fertile plants (Limpr. Laubm. **2**: 131).

ILLUSTRATIONS:—Schwaegr. l. c.; Bry. Eur. *pl. 197;* Limpr. l. c. *f. 251; Pl. 3.*

"On shaded rocks near the Glen House, and at Dixville Notch, White Mts." New Hampshire (James); "very rare." Lesq. & James, Manual, 187.

In Rhodora **3**: 184. 1901, Mr. J. F. Collins has some notes on this species. He was unable to detect any flagelliform branches on the New Hampshire plants from the White Mts. in the James Herbarium. I have examined these plants with a moderately high power, dry-mounted, at about 200 diameters, and could not find any of these shoots, but did find frondiform leaves larger than those on my Mt. Prospect plants. Because of the smallness of these frondiform leaves Mr. Collins inclined to the opinion that the American plants should be referred to *Tetrodontium Brownianum* var. *rigidum* (Funck) Jur. and better a form than a variety. To my mind it is hair splitting to call our plants even a form as the only difference seems to be in the development of the frondiform leaves. As the plants were old it may even be that the larger of these leaves had disappeared, as is the case with all the frondiform leaves in mature *T. pellucida.*

Family POLYTRICHACEAE.

The position of this family in a linear arrangement has been regarded very differently by different authors. Fleischer, Brotherus and Mönkemeyer put it last, presumably because of the greater differentiation of the gametophyte, particularly the conduction tissue of the stem. Limpricht, Jennings and others put it between the Acrocarpi and Pleurocarpi. As the distinction between these groups is largely artificial, this arrangement is unsatisfactory. Braithwaite and Dixon place it immediately after the Tetraphidaceae, presumably because of the more primitive type of peristome. This seems the most logical arrangement, as the sporophyte plays much the more important part in the taxonomy of the higher plants. This is the arrangement planned for the Moss Flora, but, due to an unavoidable delay in the preparation of the manuscript, this family will follow the Leucobryaceae instead of being placed here in its proper place. This is solely a matter of convenience to avoid delay in the publication of the work.

Family FISSIDENTACEAE.

A very distinct and homogeneous family related to the *Dicranaceae* in peristome structure but unique in leaf characters. Mostly small plants; *leaves distichous, lying in a single plane, somewhat contorted when dry, apparently split along the basal portion of the upper edge and clasping the stem and the leaf next above;* leaf cells small, smooth, mamillose or papillose, as a rule nearly isodiametric, rarely more than 1.5 : 1 (except near the base), mostly irregularly hexagonal; costa well developed, ending a little below the apex to shortly excurrent (lacking in *F. hyalinus*). Sporophyte lateral or terminal; seta several times longer than the perichaetial leaves (except in subgenus *Octodiceras*); peristome single, of 16 forked, highly colored teeth (in all our species except in *Hallianus*) resembling that of *Dicranum.*

The peculiar structure of the leaf has been explained in several ways but the following explanation is now generally accepted.*

The clasping portion of the leaf represents the original leaf while the rest of the leaf is made up of two lamellae, one dorsal the other terminal. This is strongly confirmed by the structure of the costa and the fact that the supposed lamella is wanting in the perigonial leaves and very much reduced or wanting in the earliest stem leaves. The sheathing base of the leaf is called the vaginant or sheathing lamina; the terminal lamella ventral to the costa, the apical lamina, and the dorsal lamella, dorsal lamina.

We have two genera, *Fissidens* and *Bryoxiphium.*

KEY.

Dorsal lamina well developed, equal in width to the vertical lamina above; peristome well developed ..... *1. Fissidens.*

Dorsal lamina only slightly developed; peristome lacking ..... *2. Bryoxiphium.*

FISSIDENS Hedw. Fund. **2**: 91. 1782; Sp. Musc. 152. 1801.

Skitophyllum LaPyl. in Desv. Jour. de Bot. **1814**: 133, 145.

Schistophyllum Brid. Bryol. Univ. **2**: 679. 1827.

Plants with the characters of the family, mostly under 2 cm. in height; stem with central strand; portion of leaf occupied by the vaginant laminae varying but mostly at least ½ the length of the leaf; basal leaf cells usually somewhat larger and more distinct. Capsules oblong to ovoid, erect and symmetric to cernuous and arcuate; peristome teeth mostly strongly incurved when moist, the divisions mostly rough, nodulose or spirally thickened and papillose; operculum conic-apiculate to long-rostrate; calyptra barely

* See "Annals of Botany" **13**: 103–130. 1899.

covering the operculum as a rule, smooth, usually entire or split on one side, rarely mitrate. Type species *F. exilis* Hedw.

The following arrangement of the species seems to follow the natural grouping.

Subgenus 1. EUFISSIDENS Mitt. Central strand present in the stems; leaves unistratose, bordered or not; costa present, strong, extending nearly or quite to the apex; upper leaf cells mostly rounded-hexagonal, more or less irregularly so. Seta longer than the perichaetial leaves; capsule with stomata; peristome teeth well developed, forked nearly or quite to the middle, the divisions slender and variously marked.

Section 1. *Terminales.*

Sporophyte terminal; exothecial cells for the most part shortly oblong-rectangular and collenchymatous with longitudinal walls much thicker than the transverse; divisions of the peristome teeth spirally thickened and finely papillose-roughened.

Subsection 1. **Limbatus** (Sec. *Bryoidium* C. Müll.). Leaves bordered nearly or quite to the apex by one or more rows of narrowly linear echlorophyllose cells: *minutulus* (*pusillus*), *Kegelianus*, *tortilis*, *bryoides*, *viridulus*, *limbatus*, *rufulus*, *sublimbatus*.

Subsection 2. **Semilimbatus** (section *Semilimbidium* C. Müll.). Leaves bordered as in *Limbatus* on the vaginant lamina only and often on the perichaetial leaves alone: *exiguus*, *Hallii*, *obtusifolius*, *Ravenelii*, *Garberi*, *arcticus*.

Subsection 3. **Aloma** C. Müll. (as section). Plants minute; leaves usually crenulate with projecting cell angles, at least on the upper margin, not papillose: *pauperculus*, *Closteri*, *subcrenatus*.

Subsection 4. **Crenularia** C. Müll. (as section). Like *Aloma* but with leaf cells strongly papillose: *Donnellii*.

Section 2. *Laterales.*

Sporophyte lateral in all N. American species except *osmundioides* and *Orcutti;* divisions of the peristome teeth trabeculate, nodose to appendiculate, marked with fine longitudinal or oblique lines between the nodes; leaf cells mostly bulging-mamillose: *taxifolius*, *subbasilaris*, *Bushii*, *adiantoides*, *cristatus*, *polypodioides*.

Subgenus 2. POLYPODIOPSIS C. Müll. Plants minute; stems without central strand; leaves ecostate, loosely areolate; stomata present: *hyalinus*.

Subgenus 3. PACHYFISSIDENS C. Müll. Aquatic or subaquatic; plants stiff and rigid; stems without central strand; leaves bi- tri-stratose except near the margins; stomata lacking: *grandifrons*.

Subgenus 4. OCTODICERAS Brid. (as a genus). Aquatic, long, soft, and floating; central strand lacking; seta shorter or little longer than the perichaetial leaves; stomata lacking: *Hallianus*, *fontanus* (*Julianus*), *manateensis*

Key.

1. Plants minute; leaves ecostate (POLYPODIOPSIS) ..... *27. hyalinus.*
   Plants minute to large; leaves costate ..... 2.
2. Leaves rigid, opaque, lamina of several layers of cells. (PACHYFISSIDENS) *28. grandifrons.*
   Leaves soft, unistratose ..... 3.
3. Plants slender, aquatic and floating (OCTODICERAS) ..... 4.
   Plants terrestrial, or if submerged, not floating (EUFISSIDENS) ..... 6.
4. Plants rarely over 4 cm. long; seta longer than the capsule ..... *31. Hallianus.*
   Plants 5–15 cm. long, habit of *Fontinalis* ..... 5.
5. Seta shorter than the capsule; peristome teeth truncate ..... *29. Julianus.*
   Seta longer than the capsule; peristome teeth forked and slender-pointed ... *30. manateensis.*
6. Leaves, wholly or in part, bordered with a band of narrow elongated and colorless cells; sporophyte terminal ..... 7.
   Leaves not bordered by narrower elongated cells ..... 22.
7. Border extending nearly or quite to leaf apex on both sides. (LIMBATUS) .. 8.
   Border mostly confined to the vaginant laminae. (SEMILIMBATUS) ..... 17.
8. Leaf border confluent with the costa in most leaves. (*tortilis* may be sought here) ..... *5. bryoides.*
   Leaf border ceasing below apex ..... 9.

9.	Plants 1–5 cm. long, usually submerged (Pacific Coast)	*8. rufulus.*
	Plants rarely over 5 mm., not submerged except at high water	10.
10.	Capsules symmetric, erect to inclined	11.
	Capsules more or less unsymmetric, inclined to horizontal	16.
11.	Border of vaginant lamina edged with small short cells below	12.
	Border of vaginant lamina not so edged	13.
12.	Costa reaching apex; capsules mostly inclined and unsymmetric	*6. limbatus.*
	Costa ending several cells below the apex; capsules mostly erect and symmetric	*7. sublimbatus.*
13.	Synoicous; leaf cells about 8 μ in diameter, those of the vaginant laminae little or not at all enlarged	*3. tortilis.*
	*Dioicous; most leaf cells larger than 8 μ	14.
14.	Plants 5–25 mm. high	*4. viridulus.*
	Plants rarely 3 mm. high	15.
15.	Leaf cells of the vaginant laminae reaching twice the dimensions of the dorsal and ventral	*2. Kegelianus.*
	Leaf cells of vaginant lamina only occasionally noticeably larger than those of the dorsal and ventral	*1. minutulus.*
16.	Leaves mostly oblong-lingulate, more or less apiculate; border nearly reaching the apex	*4a.* Var. *tamarindifolius.*
	Leaves oblong-lanceolate; border ceasing some distance below the apex; plants of the Gulf States	*4b.* Var. *texanus.*
17.	Costa percurrent to excurrent	*13. Ravenelii.*
	Costa usually ending 2–several cells below the apex	18.
18.	Leaf cells finely papillose	*14. Garberi.*
	Leaf cells not papillose	19.
19.	Leaves narrowly oblong, finely and evenly crenulate above with projecting cell angles	*11. Hallii.*
	Leaves oblong-lanceolate, entire or with upper margins slightly irregular	20.
20.	Leaves acute with a nearly percurrent costa	21.
	Leaves rounded-obtuse; costa ending several cells below the apex	*12. obtusifolius.*
21.	Dorsal lamina reaching the stem in most leaves	*9. exiguus.*
	Dorsal lamina not reaching the stem in any leaves	*10. arcticus.*
22.	Plants minute, about 0.5 mm. high, almost stemless	*15. Closteri.*
	Plants 2–50 mm. high; stem well developed	23.
23.	Leaves coarsely and irregularly crenulate-serrate above; sporophyte lateral	24.
	Leaves either entire or finely and evenly crenulate by projecting cell angles	26.
24.	Costa ending several cells below the leaf apex; costa covered above with short mamillose cells; leaves not bordered	*23. subbasilaris.*
	Costa percurrent; leaves (with few exceptions) with a distinct border of lighter cells; cells of costa all long and narrow	25.
25.	Leaf cells 6 x 9–12 μ; border very distinct	*25. cristatus.*
	Leaf cells 12–15 x 18–24 μ; border often indistinct	*24. adiantoides.*
26.	Leaf margins finely and evenly crenulate by projecting cell angles	27.
	Leaf margins entire, at times somewhat irregular in outline	31.
27.	Leaf cells papillose with a single large papilla	*18. Donnellii.*
	Leaf cells smooth or merely bulging-papillose	28.
28.	Sporophyte terminal	29.
	Sporophyte lateral	30.
29.	Costa ending several cells below the apex	*21. osmundioides.*
	Costa percurrent	*22. Orcutti.*
30.	Costa stout, usually short-excurrent, occasionally percurrent	*19. taxifolius.*
	Costa slender, nearly or quite percurrent	*20. Bushii.*

*See p. 11.

31. Plants large, 2–5 cm. long; sporophyte lateral ..... *26. polypodioides.*
Plants 1.5–5 mm.; sporophyte terminal ..... 32.
32. Leaves oblong-lingulate, rounded-obtuse ..... *12. obtusifolius.*
Leaves linear-lanceolate, acute ..... 33.
33. Costa ending 1–2 cells below leaf apex ..... *17. subcrenatus.*
Costa ending 8–10 cells below the leaf apex ..... *16. pauperculus.*

1. FISSIDENS MINUTULUS Sull. Mem. Am. Acad. n. s. **3**: 58. *pl. 2.* 1848.

Fissidens viridulus var. *pusillus* Wils. Bryol. Brit. 303. 1855.
Fissidens pusillus Wils. in Milde, Bryol. Siles. 82. 1869.
Fissidens incurvus var. *pusillus* Schimp. Syn. (Ed. 1) 104. 1860.
Fissidens pusillus var. *madidus* Spruce, Journ. Bot. **18**: 361. 1880.

Plants very small, 1–3 mm. long, 5 mm. at the utmost; lower leaves small and in young plants often scarcely margined, the upper, especially the perichaetial, narrowly lanceolate, often somewhat curved, 0.24–0.3 x 1–1.2 mm., at most 0.45 mm. wide in the stem leaves, usually in 3–4 pairs, occasionally more, acute, often apiculate; costa percurrent in the upper leaves; border mostly ending below the apex and apical margin usually somewhat irregular to faintly serrulate; vaginant lamina about ½ the length of the leaf, the sides often unequal; dorsal lamina narrowed at base and reaching the stem in the upper leaves only, as a rule; leaf cells irregularly quadrate to rectangular-hexagonal, about 10 μ in diameter but varying greatly in size and shape, some reaching 15 μ in longest dimension, those of the vaginant lamina near the costa often elongated to 22 μ. Mostly dioicous; seta 3–4 mm. long; capsule erect or inclined, strongly contracted below the mouth when dry and empty, obovoid; urn reaching 0.7 mm. in length but usually shorter; operculum conic-apiculate to rostrate, often nearly as long as the urn; exothecial cells quadrate to rounded-hexagonal above, rectangular below with rounded corners, collenchymatous, longitudinal walls much thicker than the transverse; peristome teeth deep red, deeply cleft, very rough and subspirally thickened with rather obscure markings; spores about 15 μ, *ripening August to September,* (occasionally as late as November at Washington, D. C.).

Type locality, N. Eastern U. S.

ILLUSTRATIONS:—Sull. l. c. & Icones Musc. *pl. 24;* Braithw. Brit. Moss. Fl. **1**: *pl. 10 B;* M. H. M. *f. 23;* Jennings, Mosses Western Pa., *pl. 10; Pl. 5.*

EXSICCATI:—Drumm. Musc. Am. S. States 39 & 40 (as *F. bryoides* vars.); Sull. Musc. Allegh. 183 (the type); Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 80 (or at least in part); Aust. Musc. Appal. 102; Holz. Musc. Acro. Bor. Am. 105, 105b; Grout, Musci Perf. 182.

Common on wet rocks in cool shaded places, occasionally on moist banks, rarely found on limestone; eastern Canada and the U. S. south to the Gulf; occasionally found west of the Rockies.

The confusion in the N. American *Limbati* is so great that a satisfactory arrangement is scarcely possible at present because there are such great variations in size, inflorescence, border and shape of capsule within the recognized specific limits. Sullivant, Icones Musc. 37, says of *minutulus* "caulis 2–3 lineas vel ultra," i.e. 4–6 mm. Barnes, Bot. Gaz. **12**: 6, says 1 mm. or less. Dixon, Handb. Brit. Mosses (Ed. 3) 126, says that the var. *madidus* Spruce of *F. pusillus* is a synonym of *F. minutulus* and is larger than typical *pusillus.* I agree with Cardot and Brotherus that *pusillus* is a synonym of *minutulus,* but I feel sure that *minutulus* merges into *viridulus* and that *viridulus* in turn merges into *bryoides* through their varieties. *Bryoides* in turn seems to have developed into the subspecies *limbatus* on the Pacific coast. The confusion is made still greater by the fact that no two authors mean exactly the same thing by the names they use. I feel sure that what Barnes called *incurvus* was a composite of forms of *minutulus, viridulus, bryoides* and occasionally *limbatus,* having curved capsules. The summer maturing of the spores may prove one of the best means of identifying *minutulus.*

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2. FISSIDENS KEGELIANUS C. Müll. Linn. **21**: 181. 1848; Syn. Musc. **1**: 49. 1849.

Fissidens clavipes Sull. Proc. Am. Acad. **5**: 275. 1861.
Fissidens monandrus Mitt. Jour. Linn. Soc. **12**: 588. 1869.
Fissidens trinitensis Hampe, in Jaeg. Adumb. **1**: 123. 1874–5.
Fissidens flexifrons Besch. Rev. Bryol. **18**: 51. 1891 (in part).
Conomitrium crassicaule Besch. l. c.

Differs from *F. minutulus* in the more slenderly acuminate, narrowly oblong-lanceolate leaves, bordered by a stronger border reaching almost or quite to the costa and often finely but sharply toothed near the

apex, sometimes nearly entire; leaf apex much like that of *F. bryoides*, but the plants are much smaller and the leaves narrower; basal cells especially those of vaginant laminae much larger than those of the upper leaf (12 μ), variable in size, up to 15 μ wide 30 μ long but the broadest cells are not the longest. Dioicous*; capsule erect and symmetric, urn 0.4–0.6 mm. long, obconic to obconic-cylindric, contracted under the mouth when dry and empty; operculum long-rostrate, sometimes nearly as long as urn; spores smooth, about 9 μ in diameter, mature in late spring or early summer.

Type locality, Dutch Guiana. *Pl. 7E.*

The cells of the vaginant laminae of *F. minutulus* are often somewhat enlarged next the costa but only to a slight degree as compared with this species.

According to Mrs. Britton (Bryol. **26**: 1. 1923) this species is common in subtropical America, ranging from southern Florida, Cuba, Haiti, Jamaica, Porto Rico, St. Thomas, St. Croix, Antigua, Guadeloupe and Martinique to Trinidad and Dutch Guiana, also in Mexico.

This seems near to *F. minutulus* and should probably be regarded as a subtropical variant. In Florida it is widely distributed from Polk Co. southwards, usually on limestone. It is also found on the bases of palms and on soil, especially clay.

3. Fissidens tortilis Hampe & C. Muell. Bot. Zeit. **22**: 340. 1864.

Similar to *F. bryoides* but dioicous; small, light yellowish, crisped, simple; leaves a few pairs, the lower remote, the upper close, when moist slightly crisped-undulate, lanceolate (*latiuscula lanceolata*), bordered throughout with a whitish subentire border; dorsal lamina narrowed toward the base; vaginant lamina more widely bordered, apical lamina with whitish costa vanishing in a very short mucro; leaf cells small, hexagonal, subopaque, more pellucid with age; perichaetial leaves similar; seta short, ascending, flexuous, becoming purple; capsule erect, symmetric, oblong, small; *operculum conic*, acute, oblique; annulus very narrow, persistent; antheridia few, on a separate plant in a terminal bud. (Translated from the original description.)

A miniature of *F. bryoides* similar in general appearance to *F. Kegelianus*, the plants seem a little larger with up to 12 pairs of leaves, usually with fewer; dorsal lamina attenuate below, often not reaching stem; leaf cells about 8 μ in diameter, hexagonal, those of the base and vaginant lamina little different; spores in winter.

Type locality, Mexico.

Specimens from Mexico have the border fused with the costa at the apex and entire; in specimens from Honduras the costa is excurrent for a cell or two, and the border does not quite reach the apex, which is almost or quite entire; in the Pineola, Florida, specimens the apex is like the Honduran except that it is often finely and sharply toothed with projecting cell angles and the costa usually vanishes in the apex. Plants from Pineola are synoicous, but there are other small plants bearing a few antheridia in a terminal bud. It is possible that these may have been attached to the female plants at base and broken apart in scraping from the limestone. Fern Grottoes, Pineola, Florida, Jan. 1936 (Grout). These Grottoes are a noted locality for rare ferns. *Pl. 7D.*

F. angustifolius Sull., whose type is Wright's Cuban Mosses no. 18, is a similar species likely to be found in Florida. It differs from *F. tortilis* in the longer and relatively narrower leaves, costa barely excurrent and more frequently fused with the border at the apex; the operculum is nearly as long as the urn, the exothecial cells are collenchymatous, quadrate with rounded corners. The basal areolation is larger and looser than that in *F. Kegelianus*, the leaf cells are smaller, about 7 μ, otherwise the two species are hard to distinguish.

4. Fissidens viridulus (Web. & Mohr) Wahlenb. Fl. Lapp. 334. 1812.

Dicranum viridulum Web. & Mohr Bot. Taschenb. 161. 1807.

Fissidens bryoides Hedw. Stirp. Crypt. **3**: *pl. 29.* 1792 (not of Sp. Musc. 153. 1801, according to Limpricht, Laubm. **1**: 429. 1887).

Fissidens exilis Funck, Moostasch. *pl. 22.* 1821 (not of Hedw. Sp. Musc. 152. 1801, according to Braithwaite).

Fissidens incurvus DeNot. Epil. 485, in part; Bry. Eur. *pl. 99*, in part; Schimp. Syn. (Ed. 1) 104. 1860 and (Ed. 2) 112. 1876.

Fissidens bryoides intermedius R. Ruthe, Rabenh. Bryoth. Eur. no. 1160. 1872.

Fissidens impar Mitt. Jour. Linn. Soc. **21**: 554. 1885.

* Originally described as dioicous. Mitten (Journ. Linn. Soc. **12**: 598. 1869) says monoicous in all the specimens he saw.

Fissidens bryoides var. *Hedwigii* Limpr. l. c.
Fissidens bryoides var. *viridulus* Broth. Laubm. Fennosk. 18. 1923.

(The *Dicranum viridulum* of Smith. Fl. Brit. 1230. 1804 was a wrong identification of a plant of *F. incurvus*, referring it to *Dicranum viridulum* Sw. Musc. Suec. 84. 1799.)

Plants about the size of *F. bryoides;* leaves typically *rounded-obtuse and apiculate; margin not reaching the apex*, often lacking in young leaves except on the vaginant lamina. Capsule symmetric, erect or inclined.

Type locality European.

ILLUSTRATIONS:—Bry. Eur. l. c.; Braithw. l. c. *pl. 12* C & D; Pl. 5C.*

On moist shaded soil; New England to Vancouver Id., south to the Middle Atlantic States, rare west of the Rockies. A sterile form approaching the European *F. crassipes* has been collected on stones in streams at Strathaven, Pa. (Krout) and at Raleigh, N. Carolina (Blomquist).

So closely related to *F. bryoides* that it is often difficult to distinguish from it. On the other hand sterile plants are often hard to distinguish from *F. minutulus.*

Plants collected in a well at New Haven, Connecticut by Browne in 1878 and named *F. bryoides caespitans* by Eaton are almost perfect *F. viridulus*, rather slender because of the shaded habitat. I have seen no American *caespitans.*

Dixon's note (l. c.) that "the long, very acute leaves distinguish this plant (i. e. *F. pusillus*) from *F. viridulus*, but specimens may often be found with the leaves broader and more approaching that plant," is in the main true, but I find narrow leaves on plants that mature spores in late autumn. Immature plants are mostly indistinguishable.

4a. Var. TAMARINDIFOLIUS (Brid.) **n. comb.**

†*Fissidens tamarindifolius* Brid. Bryol. Univ. 684. 1827 (in part); Mitt. Jour. Linn. Soc. **21:** 557. 1885.
Fissidens incurvus var. *tamarindifolius* Braithw. Brit. Moss Fl. **1:** 69, 82. *pl. 12*H.* 1887.

Differs from the species in no important particular except a curved and more or less inclined capsule. With the species. While not positively sure this is the correct name for these forms, the plants themselves agree with the description. *Pl. 5H.*

4b. Var. TEXANUS (Lesq.) **n. comb.**

Fissidens texanus Lesq. & James, Manual 86. 1884.
Fissidens incurvus var. *brevifolius* R. & C. Bot. Gaz. **14:** 94. 1889.

Leaves oblong-lanceolate, acute to acuminate; border mostly ending some distance below the apex and more or less lacking on the lower leaves and those of young plants; perichaetial leaves narrower and more narrowly acute above. Capsules more or less unsymmetric, inclined to arcuate.

Type locality, Texas.

Very common on bases of trees, cypress knees and less frequently on stones in swampy places in the Gulf States; also in Georgia.

There is no absolute certainty that this common form is the *F. texanus* of Lesq. as no trace of the type is to be found.

It is common and likely to be noted as different from the general run of what was known as *F. incurvus.* It was collected at Caloosa, Florida by J. D. Smith in 1878 and called *F. incurvus*, but it is easily distinguished from the northern form as noted above. The leaf apex is like that of *F. taxifolius* except that it lacks the border.

5. FISSIDENS BRYOIDES Hedw. Sp. Musc. 135. 1801.

Fissidens synoicus Sull. Mosses U. S. 103. 1848.
Fissidens inconstans Schimp. Syn. (Ed. 2) 114. 1876.

Stems 5–25 mm. high; leaves few to many pairs, oblong, rather abruptly short-acuminate in typical forms, in others more obtuse and apiculate, the upper and perichaetial 1.5–2 mm. long; vaginant lamina ½ the length of the leaf; border strong, especially on the vaginant lamina, *typically confluent with the costa at the leaf apex* but often vanishing slightly below it; leaf cells variable in size and shape, mostly irregularly hexagonal, 8–12 μ. Autoicous; ♂ buds in the lower leaf axils. *Capsule typically erect and symmetric*, sometimes inclined; median exothecial cells mostly oblong with very thick longitudinal walls; spores in winter.

Type locality, Germany.

† See Potier la Varde, Rev. Bryol. **41:** 85 and 94.

ILLUSTRATIONS:—Bry. Eur. *pl. 101* (as *F. exilis*); Braithw. Brit. Moss Fl. **1:** *pl. 10E;* M. H. M. *f. 21.*
EXSICCATI:—Drumm. Musc. Am. 113 (in part); Sull. Musc. Allegh. 185; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 82; Aust. Musc. Appal. 100; Holz. Musc. Acro. Bor. Am. 80b; Grout, Musci Perf. 173.
Mostly on moist soil; Canada and the U. S. east of the Rockies, south to the Gulf; Vancouver Id., Macoun, Can. Musci 121; on limestone, in Deering Hammock near Miami, Fla. Most specimens from the Pacific coast prove to *F. limbatus.*
The time of maturing spores and the broader perichaetial leaves with the erect capsule, seem the best characters for distinguishing this species from *F. minutulus.* The difference in the exothecial cell walls is doubtfully important. As regards leaf border, leaf cells, shape of capsule and peristome structure there is little constant difference between the two. I believe Monkemeyer is right in making *incurvus* a variety of *bryoides* as the reported differences in inflorescence, shape of capsule and leaf structure are either negligible or exceedingly inconstant.

5a. Var. INCURVUS (Starke) Monkem. Laubm. Europ. 142. 1927.

Fissidens incurvus Starke Ms. in Web. & Mohr, Bot. Taschenb. 161. 1870.
Fissidens Bambergeri Schimp. Syn. (Ed. 2) 115. 1876.

Leaf border less often reaching apex; capsules curved and cernuous.
Type locality, Germany.

ILLUSTRATIONS:—Jennings, Mosses W. Pa. *pl. 10;* Braithw. Brit. Moss Fl. **1:** *pl. 10C; Pl. 5* (as *F. bryoides*).
This is the *F. incurvus* of most European authors and exsiccati. Plate 99 of the Bry. Eur. represents *F. viridulus* and its var. with curved capsules, which I believe to be the *F. tamarindifolius* of Bridel, Braithwaite, and Limpricht. It would have been much better had *F. bryoides* been described as having both erect and curved capsules and no variety named.
In my opinion *F. incurvus* has been so puzzling because it has been a composite species as treated by most authors. It has included *F. tamarindifolius* Brid., *F. texanus* Lesq. and by many, forms of *F. limbatus* Sull. also. The distinctions between these are not always clear cut but the differences are usually ascertainable by careful study. Most of the *F. incurvus* in American herbaria are of the other forms mentioned above.

*6. FISSIDENS LIMBATUS Sull. Pac. R. R. Rept. **4:** 185. *pl. 1.* 1857!

Scarcely to be distinguished from broad-leaved forms of the var. *incurvus* of *F. bryoides* (of which species it is best regarded as a subspecies) except by the *smaller, more uniform and more regularly arranged leaf cells, usually not more than 10 μ in diameter and arranged in almost regular longitudinal rows;* the margin is also rather wider on the vaginant lamina, sometimes *with shorter cells on the outer edge,* and it usually ends a little below the leaf apex. Antheridial buds usually frequent and conspicuous in the lower leaf axils. Capsules light brown, *inclined to horizontal and somewhat unsymmetric,* contracted below the mouth when dry and empty; spores in winter.
Type locality, California.

ILLUSTRATIONS:—Sull. l. c.; *Pl. 6A.*
EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 105; Holz. Musc. Acro. Bor. Am. 279, 356, and 80 as *F. bryoides,* 480 as *F. incurvus;* Grout, Musci Perfecti 232 and 297 as *F. incurvus;* Baker, Pacific Coast Bryophytes, 373.
Moist shaded soil; California to New Mexico, Vancouver Island and Alberta; apparently common in California at least.
Although the distinctions between this and forms of the preceding are so slight, they seem pretty constant. In some tufts there may be some capsules erect and symmetric. *F. pusillus brevifolius* R. & C., Baker, Pacific Coast Bryophytes 368, det. by Cardot (perhaps published elsewhere) is a form of *F. limbatus* with unusually narrow leaves; the perichaetial leaves are linear-lanceolate to sword-shaped and acuminate. The plants are apparently dioicous. For it I propose the name

6a. Var. ENSIFORMIS **n. var.**

Folia angusta; folia perichaetialia anguste lanceolata, acuminata.
Collected also at Berkeley, California, Feb. 6, 1892 (M. A. Howe), Placer Co., Calif. (F. A. MacFadden), Oregon and Arizona (J. B. Leiberg).

7. FISSIDENS SUBLIMBATUS **n. sp.**

Pusillus, simplex; folia oblongo-lingulata, inferiora remota, superiora conferta, ubique limbata, nisi in apice obtusa mutica et denticulata; lamina dorsalis supra basin abrupte enata; lamina duplicaturae latius limbata cum cellulis quadratis in margine; costa sub apice finiente; capsula aequalis, obovata, 1 mm. longa.

Plants smaller than *limbatus* or *viridulus;* leaves oblong-lingulate, distant below, crowded above, 1–1.5 mm. long, *obtuse and minutely toothed and apiculate at the apex* with border not reaching apex; dorsal lamina ending some distance from the stem, *usually ending abruptly;* border of the vaginant lamina wide and edged below with 1–2 rows of *short subquadrate cells;* leaf cells obscure, bulging, the upper about 7 μ wide, subquadrate, regular and arranged in perceptible rows, longitudinal and transverse; *costa ending a few cells below the apex;* capsules small, erect and symmetric or nearly so, urn about 1 mm. long, obovoid; operculum short-rostrate; exothecial cells quadrate with rounded corners, collenchymatous; spores in winter.

Type locality, shaded ledge, Tanque Verde Mts., Pima Co., Arizona, Feb. 19, 1927 (E. B. Bartram, no. 1613). Type in Herb. Bartram. Also collected in two other localities in Arizona by Bartram, nos. 1296 & 1554 and by Orcutt in New Mexico, Guadalupe, Co. no. 7168.

ILLUSTRATION:—*Pl. 13A.*

Resembles *F. limbatus* in the small regularly arranged leaf cells and the wide border of the vaginant lamina, edged with small short cells.

8. FISSIDENS RUFULUS Bry. Eur. fasc. 46–47, Suppl. *pl. 102.* 1851.

Fissidens ventricosus Lesq. Mem. Calif. Acad. Sci. **1**: 7. 1868.
Fissidens hydrophilus Jaeger, Enum. Fissid. 20. 1869.

Plants largest of the LIMBATI, 1–3 cm. high, rarely more, dark green, blackish below, sparingly branched, with dark rhizoids among the leaves; leaves oblong-cultriform, obtuse to apiculate, 1.5–2.5 mm. long; costa strong, ending in the apex; *border nearly or quite as large in the upper ¼ of the leaf as elsewhere, almost reaching the apex;* vaginant lamina ½–⅔ the length of the leaf; dorsal lamina reaching the stem; leaf cells irregularly hexagonal, upper median 8–12 μ in longest dimension, the lower larger. Dioicous; seta 3–4 mm. long; capsule symmetric, erect or slightly inclined, urn 1–1.4 mm. long; operculum conic; peristome teeth less roughened above and with spiral thickenings more pronounced than in the others of our LIMBATI; spores 20–28 μ, maturing in winter.

Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. l. c.; Braithw. Brit. Moss Fl. **1**: *pl. 11B;* Dixon & Jam. Handb. Brit. Mosses (Ed. 3) *pl. 16K;* Sull. Icones Musc. *pl. 30; Pl. 6B.*

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 107; Grout, Musci Perf. 309.

On submerged rocks in streams; California to Washington and Idaho. Rare. The leaves of American plants as a rule are wider than those of the European and the red at base of stems found in the latter is apparently lacking in the American plants. In Holzinger's 107 the strong border all but reaches the slightly excurrent costa, approaching the European *F. rivularis* in this respect. All of our LIMBATI are variable and puzzling and seemingly intergrading. *F. rufulus* seems to be the only one in which there is any noticeable difference in the teeth. The exothecial cells vary little from those described for *F. pusillus.* The seta is usually much longer than the perichaetial leaves in *F. rufulus,* Sullivant's figures notwithstanding.

9. FISSIDENS EXIGUUS Sull. Mem. Am. Acad. Sci. n. s. **3**: 60. *pl. 2.* 1846.

Fissidens viridulus var. *Lylei* Wils. Bryol. Brit. 304. 1855.
Fissidens pusillus var. *Lylei* Braithw. Brit. Moss. Fl. **1**: 68. 1885.
Fissidens incurvus var. *exiguus* Barnes, Bot. Gaz. **12**: 6. 1887; Aust. Musc. Appal. no. 103. 1870.

Plants *very small, 1–2 mm. high;* leaves 3–6 pairs, narrowly oblong-lanceolate, acute to rounded-obtuse, the upper reaching 1 mm. in length, perichaetial a little longer, all smooth; margin entire or rarely slightly irregular near apex; in most cases only vaginant lamina of perichaetial leaves bordered; *costa usually vanishing 2–3 cells below apex;* upper median leaf cells 8–15 μ in longest dimension, irregularly rounded-hexagonal. Dioicous; seta 2–4 mm. long, pale; capsule erect and symmetric or somewhat inclined, urn reaching 0.6 mm. long; exothecial cells oblong, strongly collenchymatous; operculum long-conic to short-rostrate, *about ⅔ the length of urn;* divisions of peristome teeth spirally thickened and very strongly papillose; spores 15–20 μ, mature in summer.

Type locality, near Columbus, Ohio.

ILLUSTRATIONS:—Sull. l. c. & Icones Musc. *pl. 23;* Jennings, Mosses W. Pa. *pl. 11; Pl. 5.*

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 79, (Ed. 2) 80 (in part according to Barnes l. c.); Aust. Musc. Appal. 103.

On stones in moist shaded places; King Oscar Land, southeastern Canada and northern U. S. east of the Rockies, south to North Carolina; not common. Occasional plants have a very narrow border on the dorsal and vertical lamina.

9a. Var. FALCATULUS (R. & C.) **n. comb.**

Fissidens falcatulus R. & C. Bot. Gaz. **19**: 237. *pl. 21.* 1894.

Differs in the less crowded outwardly curved leaves, vaginant lamina of all leaves narrowly bordered with border sometimes extending a little beyond the vaginant lamina.

R. & C. Musc. Am. Sept. no. 210 has been seen. It is from the type locality and collector and fits the figures and description exactly.

Type locality, on bark of trees Catahoulou near Mandeville and Bayou Alexandre, Louisiana, 1890–1891 (A. B. Langlois).

9b. Forma EMARGINATUS **n. f.**

Folia lingulata, obtusa, breve apiculata, immarginata.

Leaves lingulate, rounded-obtuse and short-apiculate; border lacking in most plants. Type on the ground, Chincahŭa Mts., Arizona, alt. 4000 ft., Feb. 1906 (Leiberg no. 805).

10. FISSIDENS ARCTICUS Bryhn, Bryophyta in Itin. Polari Norv. Secundo Coll. 57. *pl. 1, f, 2.* Kristiana. 1906.

Plants gregarious or intermixed with other bryophytes, bright green, darker with age; stems erect, naked at base, 5–20 mm. high, simple or sparingly branched, with the leaves scarcely 1.25 mm. wide; leaves usually 6–12 pairs, erect-open, lanceolate, acute, often faintly serrate near apex, reaching 1 mm. in length; costa mostly ending a little below the apex; vaginant lamina extending at least ⅔ the length of the leaf, bordered by a narrow margin of linear cells; dorsal lamina not reaching the stem, often ending ⅓ the length of the leaf from the base, not bordered; leaf cells irregularly four-sided to hexagonal, 7–10 μ in diameter, not much rounded at the angles. Sporophyte unknown.

Type locality, King Oscar Land. *Pl. 9B.*

Also found in Greenland.

The Greenland plants have been examined through the kindness of Dr. Johannes Lid of the Oslo Museum. The notes following were made on these plants while the above description was adapted from the original description in Latin.

Distinguished from *F. exiguus* by the smaller size, smaller and more distant leaves, not or barely overlapping, faintly toothed at the apex; dorsal lamina ending some distance from the leaf base; all leaves, except the minute basal, margined on the vaginant lamina and the margin often extending slightly onto the apical lamina; costa with few exceptions ending perceptibly below the apex. The leaves at the base of the stem are very small, gradually growing larger and then suddenly becoming smaller again, then again gradually becoming larger, this alternation repeated 2–3 times. This seems to indicate a seasonal growth for 2–3 years or more.

11. FISSIDENS HALLII Austin, Bot. Gaz. **2**: 97. 1877.

Fissidens Austini Barnes, Bot. Gaz. **12**: 32. 1887.

Plants small, 2–4 mm. high; leaves 4–8 pairs, *narrowly oblong, acute,* the upper and perichaetial largest, reaching 1.5 mm. in length, *finely and regularly crenulate on the upper margin, smooth;* vaginant lamina about ½ the length of the leaf, with a few narrower elongated cells at the basal edge; costa pale, subpercurrent; upper median leaf cells not incrassate, rounded-hexagonal to subquadrate, 7–10 μ in diameter. Sporophyte terminal; seta 2–3 mm. long; capsule obovoid, erect and symmetric, urn 0.5–0.75 mm. long; exothecial cells not incrassate, oblong-rectangular, with longest dimension longitudinal at base, transverse in the middle, several rows of smaller hexagonal cells below the mouth; operculum long rostrate, a little shorter than the urn; divisions of the peristome teeth papillose and spirally thickened; spores in spring.

Type locality, Texas (Hall). *Pl. 12A.*

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 409. (As *F. falcatulus.*)

On bark of trees and logs in damp places; Florida (Rapp, Grout).

The plant described above is not rare in certain parts of Florida and is a good species, almost certainly the *F. Hallii,* of Austin. It seems doubtful if there is enough of a border to put this in the *Semilimbati.*

The narrower, more acute leaves with smooth leaf cells distinguish this from *F. Garberi;* the subpercurrent costa and the smooth leaf cells from *F. Ravenelii* and *F. Donnellii.*

12. Fissidens obtusifolius Wils. Jour. Bot. **4**: 196. *pl. 9.* 1845.

Plants *small, fertile, 2–3 mm. high,* sterile up to 1 cm., pale green, scattered to gregarious; stems simple or sparingly branched; leaves 4–8 pairs, the lower minute and distant, upper larger and crowded, upper about 1 x 0.4 mm., *oblong-lingulate, rounded-obtuse, entire;* vaginant laminae ½–⅔ the length of the leaf; *upper perichaetial leaves in most cases faintly bordered at the very base by a few inconspicuous elongated cells; costa ending a few cells below the apex;* dorsal lamina mostly tapering, sometimes not quite reaching the stem; upper median leaf cells 7–10 μ in the longest dimension, irregularly rounded-hexagonal to oblong, larger next the costa, smaller at the margin, *smooth;* slender sterile shoots often present, with numerous small distant almost elliptical leaves; many shoots, both fertile and sterile, seem to extend themselves by subapical innovations. Dioicous; sporophyte terminal; seta comparatively stout, 2–3 mm. long; capsule erect and symmetric, oblong-obovate, urn *0.5 mm. or less in length;* operculum *conic-apiculate to subrostrate;* exothecial cells shortly oblong-rectangular, collenchymatous; divisions of peristome teeth papillose, obscurely thickened spirally; *spores 18–25* μ, mature in autumn.

Type locality, Columbus, Ohio.

Illustrations:—Wils. l. c.; Sull. Icones Musc. *pl. 22;* M.H. M. *f. 24;* Jennings, Mosses Western Pa. *pl. 10; Pl. 8.*

Exsiccati:—Sull. Musc. Allegh. 181; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 78, (Ed. 2) 99; Aust. Musc. Appal. Suppl. 480; Holz. Musc. Acro. Bor. Am. 106.

On wet rocks, often submerged at high water; New England to Minnesota, Kansas and Colorado, south to Texas, Louisiana, Alabama and W. Virginia. Probably not rare but overlooked because of its small size. Occasional plants in sods of typical character will have narrower leaves with an almost triangular apex. The faint margin at the base of the vaginant laminae is usually present but difficult of demonstration. The relationship of this species to the *semilimbati* and *F. exiguus* is obvious, especially when we consider the var. *kansanus.*

12a. Var. kansanus R. &. C. Bot. Gaz.**15**: 40. 1890.

"Differs from the typical form in its leaves with a broad border of elongated cells on the margins of the vaginant laminae, and a narrow less distinct border on the dorsal wing."

Type locality, Saline Co., Kansas (Henry). *Pl. 7B.* Cumberland

Bartram's 104 from the Patagonia Mts. Southern Arizona, Feb. 17, 1924, has the border on the vaginant laminae of the fully developed leaves but not on the dorsal lamina.

12b. Var. apiculatus **n. var.**

Folia angusta, angustius obtusa, apiculata, superiora 1.4 x 0.35 mm.; costa percurrente in apicem; margine apicis non nunquam flexuoso.

Leaves narrower in proportion to length, the upper reaching 1.4 x 0.35 mm., narrowly obtuse, mostly apiculate; costa usually percurrent into the apiculus. Type Bartram's 1187, bank of dry wash, Empire Mts., Pima Co., Arizona, alt. 5000 ft., Nov. 3, 1924. Type in herb. Bartram.

The size of the leaf cells, the occasional traces of border on the margin of the vaginant lamina, dorsal lamina usually attenuate and not reaching the leaf base, indicate a close relationship to *F. obtusifolius.* Occasional leaves show papillae so faint as to be noted with extreme care only. The sporophyte is needed to settle the relationships of this plant definitely.

13. Fissidens Ravenelii Sull. Mem. Am. Acad. n. s. **4**: 171. *pl. 2.* 1849.

Plants small, 2–4 mm. high; stems simple, radiculose at base only; leaves 2–10 pairs, oblong-lanceolate, acute, upper 1 mm. or more in length, finely crenulate by projecting cell angles, bordered on the vaginant lamina only; border strong, of 3 or 4 rows of cells; vaginant lamina about ½ length of leaf; *costa strong, percurrent to subexcurrent* in all but a few of the lower leaves; leaf cells small, ± 5–7 μ, irregularly quadrate to hexagonal, *with about 2 papillae, obscure.* Monoicous or dioicous, ♂ inflorescence axillary or attached to the base of the ♀ plants by radicles; seta 3–5 mm. long; capsule oblong-ovoid, erect and symmetric, urn 0.7–0.8 mm. long, contracted below the mouth when dry and empty; exothecial cells collenchymatous, subquadrate to short-rectangular; operculum conic-rostrate, more than ½ the length of the urn; divisions of the peristome teeth spirally thickened, papillose-roughened; spores 7–9 μ, mature in spring.

Type locality, South Carolina.

Illustrations:—Sull. l. c. and Icones Musc. *pl. 25; Pl. 8A.*
Exsiccati:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 81, (Ed. 2) 192; Aust. Musc. Appal. Suppl. 481; Holz. Musc. Acro. Bor. Am. 153; Small, Mosses Southern U. S. 29; Grout, Musci Perf. 209.
On damp bricks, stones or soil; North Carolina to the Gulf, frequent in Florida.
The percurrent costa easily distinguishes this from *F. Donnellii* and *F. Garberi* which most resemble it. The bulging cells of the exothecium do not show after the capsule is thoroughly soaked up.

14. Fissidens Garberi Lesq. & James, Proc. Am. Acad. **14**: 137. 1879!

Plants small, about the same size and general appearance of the last, both macroscopically and microscopically. Leaves broader, oblong and obtuse, occasionally oblong-lanceolate and acute; border rather faint and found only on the lower part of the vaginant lamina, often difficult of demonstration; vaginant lamina rather more than ½ the length of the leaf; *costa ending several cells below the leaf apex; leaf cells obscure, papillose, 5–7 μ*; spores Feb.–March. *Pl.* ~~154.~~ 7A
Type locality, Florida.

Exsiccati:—Holz. Musc. Acro. Bor. Am. 410, 435; Grout, Musci Perf. 195.
On base of trees, dead wood and limestone rocks; Florida to Louisiana. Apparently frequent in southern and central Florida; also from Honduras. Sterile, it can be distinguished from *F. Donnellii* most easily by the 2–4 papillae on each leaf cell. Fayette, Wis. (Cheney 1891).
The *F. Garberi* and *F. Ravenelii* reported from Ontario are evidently errors. Plants so named in the herbarium of the Canadian National Museum were wrongly determined.

15. Fissidens Closteri Aust. Bull. Torr. Club. **5**: 21. 1874.

Plants minute and almost stemless; leaves 2–3 pairs, the lower ovate with little or no dorsal lamina, the upper lanceolate from an ovate base, about 0.4–0.6 mm. long; border lacking; margin entire or wavy above; vaginant lamina about ½ the length of the leaf; dorsal lamina narrow, not reaching the base, 3–5 cells wide; costa strong, ending well below the apex; apical lamina about 3 cells wide; median cells irregularly short-rectangular, 7 x 8–18 μ, smaller at the margin; cells at lower part of vaginant lamina 10–12 x 16–32 μ. Monoicous or pseudo-dioicous; ♂ buds attached to the ♀ plants by rhizoids or separated; antheridium single; sporophyte terminal; seta relatively stout, reaching 2 mm.; capsule oblong-ovoid, erect and symmetric, urn about 0.4 mm. long; operculum conic-rostrate; calyptra covering the beak only; exothecial cells strongly collenchymatous; divisions of peristome teeth rough, spirally thickened; spores 8–12 μ.
Type locality, along Anderson's and Nagle's brooks on rocks, Palisades, Closter, New Jersey (Austin).

Illustrations:—Sull. Icones Musc. Suppl. *pl. 29; Pl. 9A.*
Exsiccati:—Aust. Musc. Appal. Suppl. 479.
In brown patches in crevices of decomposing rocks.
Very rare or overlooked because of almost microscopic size. Also from Tiverton, Rhode Island, Mrs. Handy.

16. Fissidens pauperculus M. A. Howe, Erythea **2**: 97. *pl. 1.* 1894.

Plants minute, loosely gregarious; stems decumbent or ascending, 1.5–2 mm. long in fertile plants; leaves 3–5 pairs, small below, increasing in size upwards; upper oblong to obliquely spatulate, upper and perichaetial nearly or quite 1 mm. long, *acute to short-acuminate, subentire to irregularly crenulate above with projecting cell angles; border lacking; costa stout, vanishing well below apex;* vaginant laminae unequal, ⅓–½ the length of the leaf; dorsal lamina not reaching the leaf base in the upper leaves; upper leaf cells irregularly hexagonal, smaller and rounded toward the margin, larger and oblong-rectangular near the costa, marginal row 7–10 μ in diameter, others 9–16 x 16–40 μ; cells of the vaginant lamina narrower and longer along the margin near the base. Dioicous; seta flexuous, pale, 3–5 mm. long; capsule ovoid to oblong-ovoid, inclined to cernuous, slightly arcuate when dry, urn 0.5 mm. long; operculum conic-rostellate, nearly equaling the urn in length; exothecial cells oblong-rectangular, somewhat collenchymatous, shorter near the capsule mouth; peristome normal, prongs spirally thickened; annulus pale, of 2–3 rows of cells; spores 10–14 μ, mature in spring.
Type locality, Mill Valley, Marin Co., California (Howe), on soil of moist banks with *F. limbatus.* Apparently not collected since. Type seen and original description adapted. *Pl. 9C.*

17. Fissidens subcrenatus Schimp., C. Muell. Syn. **2**: 531. 1851.

Fissidens pyrenocystis Card. Rev. Bryol. **37**: 121. 1910.

Plants small, fertile reaching 5 mm. in height with 5–8 pairs of leaves, the lowest much smaller; the upper narrowly oblong-lanceolate, obtusely acute, not margined, reaching 1.5 mm. in length; vaginant laminae about ½ the length of the leaf, unequal, one side rounded to the costa, the other continuous with the apical lamina; costa strong, mostly not quite percurrent, ending 2–3 cells below the apex; upper median leaf cells irregularly hexagonal, 15–25 μ in longest dimension, smaller near the margin, basal cells of vaginant lamina somewhat elongated; all smooth, somewhat bulging, many with a central oil drop that simulates the appearance of a papilla in surface view; vaginant laminae of inner perichaetial leaves abruptly expanded into a sheathing base, a few cells at basal margin somewhat elongated and narrower. Rhizautoicous; anteridia few on small basal plants; seta slender, about 3–5 mm. long, often bent at base when young; capsule erect and symmetric, oblong-cylindric, reaching 1 mm. in length, contracted under the mouth when dry; operculum rostrate, fully as long as the urn; exothecial cells bulging, strongly collenchymatous, rounded-subquadrate, ± 30 μ in width; calyptra covering the operculum only; peristome teeth from a short basal membrane, prongs spirally thickened and papillose.

Type locality, Mirador, Mexico (Liebmann, 1843). *Pl. 12B.*

Cardot's *F. pyrenocystis* from Jalapa, State of Vera Cruz, 4500 ft., on clay (Barnes and Land, 1908), also collected by R. M. Harper "moist clayey soil south side of ravine near Kinderlon, Lowndes Co.," Georgia, Sept. 11, 1902, no. 1615b.

Through the courtesy of the New York Botanical Garden portions of the types of both *F. subcrenatus* and *F. pyrenocystis* have been examined and there seems no doubt of the identity of the plants of the three collections. It is rather surprising that a plant of such wide distribution has been so little collected.

It is nearest *F. pauperculus*, from which it differs in the larger size, narrower leaves and more nearly percurrent costa. Its size also distinguishes it from *F. closteri.*

18. Fissidens Donnellii Aust. Bot. Gaz. **4**: 151. 1879.

Fissidens tenerrimus C. Muell. Act. Soc. Fenn. **19**: 10. 1891.
Fissidens crenato-serrulatus Card. Rev. Bryol. **36**: 70. 1909.

Plants minute, 2–3 mm. high, decumbent, rather scattered, not branched; sterile stems with 6–7 pairs of leaves, fertile with a little less, leaves crowded, overlapping, narrowly oblong; perichaetial reaching 1.5 mm., those next below about 1 mm. long, obtuse to subacute; *margins crenulate-serrate with projecting cells, not bordered;* vaginant laminae rather more than ½ the length of the leaf; *costa ending well below the apex*, in cross section with 3 large central ducts and 2 narrow stereid bands; cells irregularly hexagonal, 7–12 μ in diameter, nearly isodiametric, *sharply mamillose, each cell with a single large papilla* on each side except on the inner surface of the vaginant laminae. Autoicous, antheridia terminal on small basal plants, usually few and mixed with archegonia; sporophyte terminal; seta 2–4 mm. long, bent at base; capsule erect and symmetric, urn 0.7–0.8 mm. long; operculum about the same length, conic-rostrate; calyptra short, covering only the beak; exothecial cells oblong-rectangular, strongly collenchymatous, smaller and subquadrate in several rows below the mouth; peristome teeth spreading when dry, strongly incurved when moist, divisions spirally thickened; stomata in the short neck, few and large; spores 13–21 μ, in summer.

Type locality, on base of cypress trees, Caloosa, Florida (John Donnell Smith & C. F. Austin, 1878).

Illustrations:—Bull. N. Y. Bot. Garden **20**: *pl. 233.* 1919; *Pl. 10.*

Exsiccati:—Holz. Musc. Acro. Bor. Am. 465, on base of cypress trunks, Sanford, Florida (Rapp). Also collected on limestone, Warwick Hammock, Coconut Grove near Miami, Florida, April 5, 1931 (J. B. McFarlin & A. J. Grout).

The specimens from Coconut Grove on limestone have smaller leaf cells (few larger than about 8 μ) than the Sanford plants, but otherwise are indistinguishable. Mrs. Britton, Bull. N. Y. Bot. Garden **20**: 138–142, has numerous interesting notes on this species.

19. Fissidens taxifolius Hedw. Sp. Musc. 135. *pl. 39, figs. 1–5.* 1801.

Plants light green, darker with age, 5–20 mm. high; stems rather stout, sparingly branched from the base; leaves close, overlapping, in many pairs, oblong-cultriform, largest in the middle of the stem, ± 2

mm. long, rounded-obtuse and apiculate to subacute, *finely and evenly crenulate above with projecting cell angles;* vaginant laminae ½–⅔ the length of the leaf; dorsal lamina ending abruptly, usually reaching the stem; *costa strong, in well developed mature plants excurrent into a short mucro,* in lower leaves and on depauperate or undeveloped plants *often merely percurrent;* perichaetial leaves above the vaginant lamina narrow, linear or sword-shaped; upper median cells 7–10 μ, bulging-mamillose, smaller and often somewhat lighter colored at the margins, larger near the costa; perichaetial leaves often with terminal and dorsal lamina narrow, almost lacking; ♂ buds on short branches rooting at base. Sporophyte axillary near the base; seta 8–15 mm. long, ascending, flexuous; capsule oblong, contracted under the mouth when dry, urn ± 1.5 mm. long, somewhat inclined to nearly pendulous, mostly somewhat curved and unsymmetric; calyptra covering nearly ½ the urn, split on one side; exothecial cells oblong to subquadrate, incrassate, with many rows of smaller very incrassate isodiametric cells below the mouth; operculum conic, long and obliquely rostrate, beak fully the length of the urn; peristome teeth deep red, the divisions strongly nodulose and marked with very fine oblique lines between the nodes; spores 15–20 μ, mature Nov. to March.

Type locality, European.

Illustrations:—Bry. Eur. *pl. 104;* Hedw. l. c.; Braithw. Brit. Moss Fl. **1**: *pl. 12A;* Jennings, Mosses W. Pa. *pl. 11;* M. H. M. *f. 26; Pl. 10. ♂*

Exsiccati:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 83, (Ed. 2) 106; Aust. Musc. Appal. 107; Holz. Musc. Acro. Bor. Am. 177, 467; Grout, Musci Perf. 173.

On damp shaded soil, Canada and the eastern U. S., south to central Florida and Missouri. Common.

Young sterile shoots sometimes approach *F. osmundioides* in leaf characters, but in that species the costa in most instances ends several cells below the apex.

From all forms of *F. cristatus* and *F. adiantoides* it is easily separated by the evenly crenulate upper margin scarcely lighter in color.

Some European plants (e.g. Cardot, Musc. Eur. 116) have the costa much more strongly excurrent than in most American plants, but specimens from Sweden, com. Möller, match the American plants almost perfectly.

20. Fissidens Bushii Card. & Thér. Bot. Gaz. **37**: 365. 1904.

Fissidens subbasilaris var. *Bushii* Card. & Thér. Bot. Gaz. **30**: 16. 1900.

Plants smaller than *F. cristatus;* leaves oblong, rounded-obtuse and apiculate to broadly acute, *finely and evenly crenulate-serrate, without lighter border; costa nearly or quite percurrent;* upper median leaf cells 7–10 μ in diameter. *Sporophyte lateral from near the base of the plant;* seta 6 mm. or more long; capsule ovoid, urn about 1.2 mm. long, operculum rostrate, a little shorter; divisions of the peristome teeth appendiculate. Description based on a type duplicate from Eagle Rock, Missouri, com. M. Thériot. *Pl. 12C.*

Distinguished from small forms of *F. taxifolius* by the more slender costa, barely or not quite percurrent; from *F. subbasilaris* by the evenly crenulate margin, percurrent costa, pellucid and of linear cells; from *F. osmundioides* by the smaller leaf cells and lateral sporophyte. It is nearest to *F. cristatus winonensis* but distinguished by the entire lack of lighter border and finely and regularly crenulate upper margin.

Owen Sound, Ontario, (Macoun, Can. Musci 767, 768); several localities in N. Carolina; near Easton, Pa. (Small); Thomasville, Georgia, Holz. Musc. Acro. Bor. Am. 136 (as *F. polypodioides*); Vt. (Miss Lena Henderson).

21. Fissidens osmundioides Hedw. Sp. Musc. 153. *pl. 40, figs. 7–11.* 1801.

Plants of medium size, 1–3 (rarely 8–10) cm. high, in rather close mats, more or less tufted together at base by brown rhizoids, olive to dark green; stems erect, simple or sparingly branched; leaves numerous, close and slightly overlapping, the upper often larger, cultriform to lingulate or oblong-lanceolate, *rounded-obtuse and often apiculate to* broadly acute, 1–2 x 9.5 mm., *finely and evenly crenulate above with projecting cell angles, without border,* vaginant laminae ½–⅔ the length of the leaf, unequal, narrowed in upper and perichaetial leaves to meet the apical lamina; *costa ending a little below the apex;* dorsal lamina usually ending abruptly at the nondecurrent base; upper median leaf cells irregularly hexagonal, bulging, *12–20 μ, marginal, smaller.* Dioicous; sporophyte terminal; seta 5–10 mm. long; capsule erect and symmetric, chestnut-brown, oblong-obovoid; urn reaching 1.8 mm. in length; operculum needle-beaked, nearly as long as the urn; exothecial cells irregular and very incrassate; calyptra many-lobed at base; divisions of the peristome teeth not spirally thickened but nodulose and marked with very fine longitudinal lines between the nodes; spores 18–25 μ, finely papillose, mature summer to autumn.

Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 103;* Braithw. Brit. Moss. Fl. **1**: *pl. 11A;* M. H. M. *f. 25:* Hedw. l. c.

EXSICCATI:—Drumm. Musc. Am. 112; Sull. Musc. Allegh. 179; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 86, (Ed. 2) 109; Aust. Musc. Appal. 104; Grout, Musci Perf. 190; Holz. Musc. Acro. Bor. Am. 35; Macoun, Can. Mosses 63 (as var. *canadensis* Kindb.).

On moist shaded soil, widely distributed in eastern N. America and apparently common in the cooler portions; Yukon to Newfoundland and northward, south to Vancouver Id., Idaho, Missouri, Ohio, North Carolina and Tennessee. Spores from Cape Breton were ripe in July, while in Ontario they were ripe in November. Tallulah Falls, Ga. (Small

22. FISSIDENS ORCUTTI **n. sp.**

Plantae humiles in densis et tenuibus caespitibus degentes; caulis 1.5–2 mm. altus; folia 6–11 juga, inferiora minima; superiora majora, conferta, 0.8–1.25 mm. longa, oblongo-lanceolata, acuta vel apiculata, emarginata, toto ambitu crenulo-serulata; duplicatura ad medium producta, inaequalis, superne angustata in foliis superioribus et perichaetialis; lamina dorsalis ad basin sensim evanida; costa flexuosa, percurrente; cellulis 7–12 μ latis, ad marginem minoribus. Flores dioici, terminales; capsula in pedicello 3–3.5 mm. longo, obovata, 0.5 mm. longa, aequalis; operculo conico-rostrato.

Plants small, in thin close wide mats over clay soil, 1–5–2 mm. high; leaves 6–11 pairs, smaller at base of stem and spaced; the upper overlapping, reaching 1.25 mm. long, oblong-lanceolate, acute to apiculate, not bordered, crenulate along the entire margin by projecting cell angles; dorsal lamina gradually very attenuate, usually reaching the stem; vaginant laminae unequal, about ½ the length of the leaf in the upper and perichaetial leaves, and narrowed at the junction with the wider apical lamina, giving the leaves a characteristic incurved outline on the ventral margin; costa strong, flexuous, percurrent, subexcurrent in the apiculate leaves; upper leaf cells irregularly hexagonal, 7–12 μ in longest dimension, smaller at the margin, larger near the costa, somewhat bulging; basal cells of vaginant lamina somewhat larger. Dioicous; male plants smaller, with 2–3 pairs of leaves; seta terminal, over 3 mm. long, apparently flexuous but immature; capsule immature but apparently erect and symmetric, obovoid, about 0.5 mm. long; operculum conic-rostrate; exothecial cells quadrate to short-rectangular, collenchymatous and rounded at the corners; spores in winter. Type from near New Orleans, Louisiana, Feb. 3, 1927 (Orcutt), com. Bartram. Type in herb. Bartram. *Pl. 13B.*

Differs from *F. osmundioides* in smaller size, narrower leaves and attenuate dorsal lamina and percurrent costa.

23. FISSIDENS SUBBASILARIS Hedw. Sp. Musc. 155. *pl. 39, figs. 6–9.* 1801.

Plants small, 5–10 mm. high, scattered to closely gregarious, erect or ascending; stems simple or branching, leaves 10–18 pairs, somewhat crispate when dry, close and overlapping, oblong, obtuse, or subacute and apiculate by a projecting cell, those in the middle of the stem usually the largest, reaching 1–1.5 mm. in length, *minutely and evenly crenulate below by projecting cell angles, minutely and irregularly serrulate above by larger cells; border none;* vaginant lamina reaching about ½ the length of the leaf; dorsal lamina usually ending abruptly before or after reaching the stem; *leaf cells rather obscure, 7–10 μ in the upper middle of the leaf, strongly and bluntly mamillose both sides,* irregularly rounded-hexagonal, incrassate, larger and less obscure in the base of the vaginant lamina; costa strong, *covered and obscured with mamillose cells in the upper part,* ending several cells below the apex. Dioicous; sporophyte arising from a leaf axil near base of stem; seta 3–5 mm. long, reaching about to the top of the stem; capsule oblong-cylindric, erect and symmetric or slightly curved, brown, urn rather more than 1 mm. long; exothecial cells scarcely collenchymatous; operculum conic-rostrate, about ½ the length of the urn; peristome teeth nodulose above, not spirally thickened or papillose; spores 16–18 μ in diameter, mature in autumn.

Type locality, near Lancaster, Pennsylvania (Muhlenberg).

ILLUSTRATIONS:—Hedw. l. c.; Sull. Icones Musc. *pl. 26;* Jennings, Mosses W. Pa. *pl. 12;* M. H. M. *f, 27; Pl. 7C.*

EXSICCATI:—Drumm. Musc. Am. 111, S. States 42; Sull. Musc. Allegh. 184; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 84, (Ed. 2) 107; Aust. Musc. Appal. 105; Holz. Musc. Acro. Bor. Am. 466; Grout, Musci Perf. 285; Small, Mosses of Southern U. S. 16 (as *F. decipiens*).

On soil, stones and base of trees; Ontario and Connecticut, southward to the Gulf east of the Mississippi. Common on bases of trees in Florida but fruiting sparingly.

Sterile it might be confused with *F. Donnellii*, but in that species the mamillae are more like large papillae, the leaves are finely and evenly crenulate to the very apex and the dorsal lamina ends less abruptly. *F. cristatus* has the costa plainly percurrent and of elongated cells at the apex, and in most cases the lighter border is very apparent.

24. Fissidens adiantoides Hedw. Sp. Musc. 157. 1801.

Typically larger than the next with border less distinct to lacking; *upper median leaf cells 15 μ or larger;* often difficult to distinguish.

Illustrations:—Bry. Eur. *pl. 105* and M. H. M. *pl. 9;* Braithw. Brit. Moss Fl. **2:** *pl. 12B.*
Exsiccati:—Aust. Musc. Appal. 106; Grout, Musci Perfec. 124.
In much the same habitats as the next; Cape Breton Id. to Vancouver Id., south to California and Florida (including the var. *semicristatus*).
Size is no decisive distinction between this and the next, neither is the inflorescence, as each may be either monoicous or dioicous. Both species vary greatly in height and width of fronds. The size of the leaf cells seems the only reliable distinction and there are many intermediate forms. Forms without perceptible border have been called var. *immarginatus* by Barnes (Bot. Gaz. **12:** 27. 1887).

24a. Var. semicristatus **n. var.**

Plantae largiores; folia elimbata; cellulae folii 10–12 μ, quandoque 15 μ.
Plants of a large size, leaf cells intermediate between this and the next, 10–12 μ, occasionally reaching 15 μ; leaf border scarcely visible. Type from near Lake Worth, Florida, March 23, 1934 (A. J. G.).

Also collected by Small (no. 7209) in Dade Co. and Lee Co. (7263). Apparently common in southern Florida. Similar forms of a lesser size are found farther north.
The full description is given of the next because it is very common.

25. Fissidens cristatus Wils. Kew Jour. Bot. **9:** 294. 1857.

Fissidens decipiens DeNot., in Piccone Elench. Musch. lig. no. 181. 1863.
Skitophyllum marginatum La Pyl. var. β. of *F. adiantoides* Desv. Jour. Bot. **4:** 163. 1814.
Fissidens dubius P. B. Prod. 57. 1805.?
Fissidens rupestris Wils. Musc. Brit. no. 31; Jaeger, Enum. Fiss. 25. 1879.
Fissidens floridanus Lesq. & James, Proc. Am. Acad. **14:** 137. 1869.

Plants in rather close dark green sods 1–3 cm. high; leaves numerous, overlapping, oblong-lingulate to oblong-lanceolate, 1.5–2.5 mm. long, acute to rounded and subapiculate, *bordered by a band of lighter colored cells, irregularly crenulate-serrate above;* vaginant lamina about ½ the length of the leaf; costa percurrent or nearly so; leaf cells irregularly hexagonal, bulging-mamillose, 6–10 μ, a few 12 μ, bistratose in places. Dioicous; sporophyte lateral; perichaetial leaves broadly ovate with a very small and narrow dorsal and apical lamina: seta 1–4 mm.; capsule inclined to horizontal, oblong, narrowed to the seta, urn 1–1.5 mm. long; operculum long-rostrate, nearly as long as the urn; exothecial cells incrassate, oblong to quadrate or hexagonal; divisions of peristome teeth strongly trabeculate with fine longitudinal and oblique lines between the nodes below, appendiculate and finely papillose at the top; spores 10–15 μ, mature late autumn to winter.
Type locality, Khasia Mts. India.

Illustrations:—Braithw. Brit. Moss Fl. **1:** *pl. 11D;* Jennings, Mosses Western Pa. *pl. 11; Pl. 6.*
Exsiccati:—Drumm. Musc. Am. 110 (as *F. adiantoides*), S. States 41 (as *F. adiantoides marginatus*); Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 85 (as *F. adiantoides*); Holz. Musc. Acro. Bor. Am. 34, 81, and 391 (as *F. adiantoides*); Grout, Musci. Perf. 6.
On moist shaded soil and stones, occasionally on the base of trees; common. Eastern N. America, Nova Scotia to the Gulf, west to the Rocky Mts. and in all the continents of the Northern Hemisphere.
In this species, and more frequently in the preceding, plants occur with the pale border faint or lacking, but the irregularly crenulate-serrate apex distinguishes both from all but *F. subbasilaris* even when sterile, and that species has the costa ending several cells below the leaf apex and also mamillose roughened on the surface.
In response to an inquiry, Mr. H. N. Dixon states that he thinks there is no doubt that *F. cristatus* Wils. is the same as *F. decipiens* DeNot. and he adds that Fleischer also concurred in this opinion. At my request he examined authentic specimens of *F. floridanus* Lesq. & James (Dr. Garber, no. 39. 1877) in the Kew herbarium and writes me that "It is exactly our *F. decipiens* or *F. cristatus*, a rather small form."
Mrs. Britton (Bryol. 8: 49. 1905) states that *F. dubius* P. B., *Skitophyllum marginatum* La Pyl. and *S. adiantoides marginatus* La Pyl. are all based on the same plants collected in America by Beauvois, but without record of the locality. It is probable that *F. dubius* P. B. is the proper name for this plant, but Dr. Pierre Allorge writes me that the types are not in the Paris Museum.

25a. Var. WINONENSIS (R. & C.) **n. comb.**

Fissidens decipiens winonensis R. & C. Bot. Gaz. **22:** 3. 1896.

"Differs from the type by its smaller size, the smaller and narrower leaves with the pellucid border most often indistinct, and the less opaque areolation."

Type locality, Winona, Minnesota; Holzinger, Mosses of Minnesota, no. 6.

What appears to be a portion of the type collection has been seen. The costa ends a cell or two below the apex. It differs from *F. subbasilaris* in the longer smooth costa; from *F. Bushii* in the irregularly crenulate-serrulate apex. I have it also from Ft. Worth, Texas, and near Columbus, Ohio.

26. FISSIDENS POLYPODIOIDES Hedw. Sp. Musc. 154. 1801.

Plants large, 2–5 cm. long, gregarious, yellowish-green; stems simple or branching from the base, rooting at base only, erect to ascending; leaves numerous, barely overlapping, oblong-lingulate, *rounded-obtuse with a short blunt apiculus, or rarely subacute, entire, about 3 mm. long,* not bordered; vaginant lamina ½ the length of the leaf or more; costa strong, almost percurrent; leaf cells irregularly hexagonal, pellucid, smooth; *upper median 10–15 μ, larger near the costa and much smaller at the margin.* Dioicous; sporophyte from the upper leaf axils, sometimes subterminal; seta about 1 cm. long; capsule elongated-obconic, or subpyriform, contracted under the mouth when dry and empty; operculum rostrate, equaling ½ the length of the urn; annulus large, revoluble; divisions of the peristome teeth nodulose.

Type locality, Jamaica, W. I.

ILLUSTRATIONS:—Sull. Icones Musc. *pl. 27; Pl. 11.*

EXSICCATI:—Drumm. Musc. Am. S. States 38; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 87, (Ed. 2) 110.

On moist shaded banks and ledges; Georgia, Alabama, Louisiana, and Florida; Fern, Indiana (Underwood). Mostly sterile in the U. S. but easily recognized by its large size and lingulate entire leaves. Sullivant's figures show the leaves too acute for most of our plants.

27. FISSIDENS HYALINUS Hook. & Wils. Jour. Bot. **3:** 89. *pl. 2.* 1841.

Plants 2–3 mm. high, pale green, hyaline; stems mostly simple; leaves 3–5 pairs, upper much larger, 1–1.5 mm. long, *very thin and soft,* oblong-lanceolate, acute, *entire, ecostate; leaf cells oblong-hexagonal, about 30 x 45–60 μ, very thin-walled, a single row at the margin narrow and elongated.* Dioicous; sporophyte terminal; seta 1–2 mm. long, capsule oblong-ovoid, erect and symmetric, operculate about 1 mm. long, operculum long-rostrate, a little shorter than the urn; calyptra cylindric-conic, covering the beak only; peristome normal; spores 11–15 μ, in autumn.

Type locality, "moist rocky ledges, Bank Lick, near Cincinnati, Ohio (Lea, 1839, station lost).

ILLUSTRATIONS:—Sull. Icones Musc. *pl. 21; Pl. 11.*

EXSICCATI:—Sull. Musc. Allegh. 180.

On soil and ledges in cool shaded ravines; very rare or overlooked; two other localities are near Painesville, Ohio and another at Washington, Pennsylvania.

28. FISSIDENS GRANDIFRONS Brid. Sp. Musc. **1:** 170. 1806.

Plants large, 3–15 cm. long, fronds 3–4 mm. wide, *dark green,* often dark-brown and lime-encrusted below, much divided and branched, especially near the base, *rigid and suberect;* leaves numerous, of equal length, 2–3 mm., *crowded and overlapping, rigid and opaque,* linear-lanceolate, entire, not bordered, narrowly obtuse; vaginant lamina more than ½ the length of the leaf; *leaf cells in one layer at the margin, in several at the costa, irregularly hexagonal, 7–12 μ in diameter;* costa strong, vanishing in the apex. Dioicous; sporophyte lateral from the upper leaf axils, rarely produced; seta up to 1.5 cm. long; capsule erect and symmetric or nearly so, oblong, urn about 1.2 mm. long; operculum conic-rostrate, about 1 mm. long; peristome teeth deeply inserted, the divisions rough; spores 15–24 μ.

ILLUSTRATIONS:—Bry. Eur. *pl. 106;* M. H. M. *f. 28.*

EXSICCATI:—Sull. Musc. Allegh. 186; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 88, (Ed. 2) 111; Aust. Musc. Appal. Suppl. 483; Holz. Musc. Acro. Bor. Am. 135.

On wet rocks with trickling water or submerged in streams in limestone regions; southern Canada, Alberta to Ontario, Washington to California, east to New York, West Virginia and Tennessee. Apparently frequent but local.

29. Fissidens Julianus (Mont.) Schimp. Flora **21**: 271. 1838.

Skitophyllum fontanum LaPyl. Journ. Bot. Desv. **4**: 158. *pl. 34, f. 2.* 1814.
Fissidens debilis Schwaegr. Suppl. **1**[2]: 11. 1816.
Fontinalis Juliana Mont. Anal. Soc. Nat. **8**: 246. *pl. 4.* 1837.
Octodiceras fontanum Lindb. Bidrag. Moss. Synom. 23. 1863.
(not *Fissidens fontanus* of Schimp. 1878).

Plants long slender and floating, habit of Fontinalis, 5–15 cm. long, flaccid, blackish-green below; stems filiform, branching by innovations along the whole length; leaves distant, spreading, numerous, linear-lanceolate, entire, without border, obtusely-acute, reaching 3–6 mm. in length; vaginant lamina about ⅓–¼ the length of the leaf; dorsal lamina usually not reaching the base; costa vanishing some distance below the apex; upper median leaf cells irregularly hexagonal, inclining to quadrate below, 14–24 μ in longest dimension, larger near the costa, much smaller at the margins, thin-walled. Monoicous, ♂ and ♀ inflorescences terminating short axillary branches; *seta shorter than* the capsule; capsule elliptic, urn about 0.5 mm.; operculum fully as long as the urn, conic-rostrate; *peristome teeth truncate, irregularly cleft and perforate above*, papillose; spores 18–21 μ, mature in summer.

Type locality, European.

Illustrations:—Bry. Eur. *pl. 108;* Limpr. Laubm. **1**: *f. 145;* M. H. M. *pl. 10.*
Exsiccati:—Drumm. Musc. Am. S. States (as *F. semicompletus*); Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 89, (Ed. 2) 112; Aust. Musc. Appal. 187; Holz. Musc. Acro. Bor. Am. 265, 335; R. & C. Musc. Am. Sept. 16b;Bartram, Mosses S. Arizona 11.

Submerged on stones and logs; Washington, Ontario and Vermont; south to California, Arizona and Florida; also in S. America and Europe. Varying in slenderness and in the width and distance apart of the leaves; frequent but fruiting sparingly.

W. H. Emig, Bryol. **21**: 60. *pl. 26*, describes a var. *ohioense*, but in an aquatic moss the differences he notes do not seem worthy of varietal rank or even of special mention.

30. Fissidens manateensis Grout, in Holz. Musc. Acro. Bor. Am. 590. 1926; Bryol. **31**: 30. *pl. 3.* 1928.

Very similar to the last and difficult to distinguish when sterile. Leaves averaging smaller and narrower; dorsal lamina ending less abruptly and usually more nearly reaching the stem; cells just above the vaginant laminae 15–21 μ, irregularly subquadrate to hexagonal. Monoicous; male flowers terminating short axillary branches bearing bract-like leaves; perichaetial leaves longer than those below, several times as long as the capsule and seta; *seta terminal at the end of a main branch, 1–3 mm. long, plainly longer than the capsule*, which is obvoid with a long-conic operculum; *peristome teeth deeply cleft, divisions long, slender, and obliquely striate above;* spores about 15 μ, mature in early spring. Type locality and habitat, attached to a log in a creek near the road from Oneco to Arcadia, Manatee Co., Florida. March 9, 1926. Also, Caloosa, Florida, J. D. Smith 1878 as (*F. Hallianus*).

Illustrations:—Bryol., l. c.; *Pl. 12D & 4A.*
The spores were not ripe in most capsules and in some of the unripe capsules the teeth were not fully developed but they were not truncate and in fully ripened capsules the teeth were perfect. Probably common in peninsular Florida but rarely fruiting and confused with *F. fontanus.* Julianus (? MFI 250

31. Fissidens Hallianus (Sull. & Lesq.) Mitt. Jour. Linn. Soc. **21**: 551. 1885.

Conomitrium Hallianum Sull. & Lesq. in Aust. Musc. Appal. 108. 1870.
Octodiceras Hallianum Jaeger & Sauerb. Adumb. 33. 1874.

Much smaller and more slender than the two preceding, 3–4 cm. long; seta several times longer than the capsule; *peristome teeth undivided*, papillose in fine lines. Julianus ?

Type locality, on stems of *Cephalanthus occidentalis* with *F. fontanus* in a sunken hole at Athens, Illionois.

Illustrations:—Sull. Icones Musc. Suppl. *pl. 28; Pl. 10A.*
Habitat same as that of the two preceding; New Jersey, New York, Illinois, Idaho (Leiberg).

J. D. Smith's Florida plants, referred to this species for over fifty years, have well developed forked teeth and belong to *F. manateensis.*

Leiberg's plants from Idaho are sterile; the leaves very narrow, the upper about 0.15 mm. wide and

reaching 3 mm. long; in the larger leaves the vaginant laminae are 1/10 to 1/8 the length of the leaf. They may be a different species.

BRYOXIPHIUM Mitt. Jour. Linn. Soc. **12**: 580. 1869.

Eustichia C. Muell. Syn. **1**: 42. 1849 (in part).

Plants slender, bright to yellowish green, more or less gregarious and silky; stems simple, stiff, radiculose and bulblike at base, central strand present; leaves closely imbricated, distichous, keeled, smooth, with a very narrow dorsal lamina not reaching the base; costa vanishing at or near the apex except in the abruptly long subulate-acuminate perichaetial leaves. Dioicous; seta shorter than the perichaetial leaves; capsule globular to obovate, smooth, peristome and annulus lacking; operculum slightly convex and rostrate; calyptra smooth, covering about 1/3 of the urn, cucullate. Type species, *B. norvegicum.*

Bryoxiphium norvegicum (Brid.) Mitt. l. c.

Phyllogonium Eustichia norvegica Brid. Bryol. Univ. **2**: 674. 1827.
Eustichia norvegica C. Muell. l. c.
Fissidens imbricatus Desv. in Brid. l. c.

Plants 1–2.5 cm. long; leaves of middle stem, lanceolate, serrulate at apex and acute to subulate, reaching 2 mm. long; upper and perichaetial leaves long-subulate-acuminate from an ovate base; dorsal lamina scarcely apparent except on upper and perichaetial leaves. Seta rather thick, about 2 mm. long, capsule obovate, pale yellow, reddish at mouth; operculum attached to the columella and long-persistent.

Illustrations:—Bry. Eur. *pl. 195;* Sull. Mem. Am. Acad. N. S. **3**: *pl. 1;* E. G. Britton, Plant World, **1**: 11. 1897 and Bull. Torr. Club **10**: 100. figs. 1–5. 1883; *Pl. 27.*
Exsiccati:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 109; Holz. Musc. Acro. Bor. Am. 10.
On shaded moist, usually vertical, faces of sandstone, Greenland, Minnesota, Wisconsin, Central Ohio, Kentucky, Tennessee and Western Pennsylvania; rare and infrequently fruiting. The leaves are so closely appressed that the whole plant appears as a single smooth shining strand with a tuft of filaments at the summit in the fertile plants.

Family ARCHIDIACEAE.*

By Dr. Stanley A. Cain.

Small, perennial, terrestrial mosses growing in meadows and bare places, usually in siliceous sand; branches erect, slender, subapical and flagellate with rudimentary leaves below. Stem leaves small, lanceolate-acuminate, costate, entire or serrate. Perichaetial leaves usually longer and broader than the stem leaves, often subulate by the excurrent costa. Calyptra small, fugacious, rupturing irregularly. Capsule small, spherical with a short, broad seta surrounded by a thick cup-like vaginule, indehiscent, without columella, lid, or stomata, the spore-sac filled with a few very large rounded or polyhedral spores, the largest of any known moss. Monoicous or (in one South American species) dioicous.

1. ARCHIDIUM Brid. Bryol. Univ. **1**: 747. 1827.

Plants perennial, small, 2–20 mm. tall, usually 5–10 mm., branching by subapical innovations, with erect fruiting stems. Branches slender with small, distant, lanceolate-acuminate leaves, sometimes capitate (*Euarchidium*, in North America and Europe). Perichaetial leaves usually longer and broader,

* Grateful acknowledgment is made of the work of Mrs. E. G. Britton (N. Amer. Flora **15**[1]: 45–46. 1913), from whose monograph of the Archidiaceae the writer has drawn freely for this revision. The author is especially indebted to Mr. Aaron J. Sharp, The University of Tennessee, for assistance in many ways, and to Dr. A. J. Grout, The Biological Laboratory, Cold Spring Harbor, New York, for writing the Latin diagnosis of Austin's heretofore unpublished species. The *Archidium* materials of the following herbaria were examined by the writer and appreciation is extended to the curators: The Brooklyn Botanic Garden, A. J. Grout, The University of Michigan, The Missouri Botanical Garden, The New York Botanical Garden, The Sullivant Moss Society, The University of Tennessee, and The United States National Herbarium.—

Stanley A. Cain, The University of Tennessee (Contribution No. 9, New Ser.) and The Biological Laboratory, Cold Spring Harbor, June, 1936.

lanceolate-acuminate to ovate-subulate, entire or serrulate. Capsules 1–8, usually not more than 3, terminal or appearing lateral by successive branches, or axillary on a short branch, with a short thick seta surrounded by the vaginule. Spores few, rounded or polyhedral, smooth or finely granular.

Type species: *Archidium alternifolium.*

Key.

1. Paroicous: antheridia and archegonia in the same cluster but not mixed, antheridia in axils of perichaetial bracts below the archegonia ..... 2.
   Autoicous: antheridia and archegonia on the same plant but not in the same cluster ..... 3.
2. Stem leaves 1 : 5; median cells 1 : 4, averaging about 60 μ long ..... 1. *alternifolium.*
   Stem leaves 1 : 7–10; median cells 1 : 10–12, reaching 100 μ long ..... 2. *longifolium.*
3. Gonioautoicous: antheridia axillary on a fruiting branch in a bud-like cluster with 3–4 ecostate perigonial leaves ..... 4.
   Cladautoicous: antheridia terminal on a special proper branch, perigonial leaves costate ..... 5.
4. Capsule 250–325 μ in diameter, spores 145–175 μ in diameter; stem leaves 1 : 4, mostly about 0.7 mm. long; plants seldom over 10 mm. high ..... 3. *ohioense.*
   Capsule 430–540 μ in diameter, spores 180–210 μ in diameter; stem leaves 1 : 7, most about 1.4 mm. long; plants frequently 20 mm. high ..... 4. *floridanum.*
5. Median perichaetial leaf cells 1 : 8–10 ..... 5. *Donnellii.*
   Median perichaetial leaf cells 1 : 4–5 ..... 6.
6. Capsule 360–500 μ in diameter; spores smooth, about 210 μ in diameter ..... 6. *Hallii.*
   Capsule not over 360 μ in diameter, usually less; spores granular, 125–140 μ in diameter ..... 6a. *Hallii* var. *minus.*

Special Key.

Due to the frequent difficulty attending the observation of the antheridia in *Archidium* and consequently determining whether the plants are paroicous or autoicous (and for the latter whether gonioautoicous or cladautoicous) the following special key is provided which omits these characters:

1. Plants conspicuously capitate (large leaves clustered at the ends of fertile and sterile stems, leaves progressively smaller and more widely spaced below becoming reduced to mere bracts) ..... 2.
   Plants not conspicuously capitate ..... 4.
2. Perichaetial leaves not over 1.5 mm. long; spores minutely but completely granulate ..... 6a. *Hallii minus*
   Perichaetial leaves reaching 2.0 mm. in length; spores smooth ..... 3.
3. Median perichaetial leaf cells 1 : 8–10 ..... 5. *Donnellii.*
   Median perichaetial leaf cells 1 : 4–5 ..... 6. *Hallii.*
4. Stem leaves 1 : 7 or proportionately longer ..... 5.
   Stem leaves 1 : 4–5 ..... 6.
5. Perichaetial and stem leaves about the same length ..... 4. *floridanum.*
   Perichaetial leaves conspicuously longer than the stem leaves ..... 2. *longifolium.*
6. Stem leaves mostly 0.7 mm. long (occasionally as much as 1.3 mm.), perichaetial leaves reaching 1.5 mm. in length ..... 3. *ohioense.*
   Stem leaves commonly reaching 1.5 mm. in length, perichaetial leaves up to 2.5 mm. long ..... 1. *alternifolium.*

1. Archidium alternifolium (Dicks. Hedw.) Schimp. Syn. 28. 1860.

Phascum alternifolium Dicks. Pl. Crypt. Brit. **1**: 1. 1785; Hedw. Sp. Musc. 24. 1801.
Phascum globiferum Bruch, Flora **8**: 281. 1825.
Pleuridium globiferum Brid. Musc. Recent. Suppl. **4**: 10. 1819; Bryol. Univ. **2**: 162. 1827.
Archidium phascoides Brid. Bryol. Univ. **1**: 747. 1827.

Phascum Bruchii Spreng. Syst. **4:** 142. 1827.
Archidium tenerrimum Mitt. Jour. Linn. Soc. **8:** 17. 1864.
Archidium Lescurii Aust. Bull. Torr. Club **6:** 144. 1877.
Archidium Ravenelii Aust. Bull. Torr. Club **6:** 145. 1877.

Plants perennial in close low tufts, yellow-green; stems at first simple, not more than 5 mm. high, later branching from the axils of perichaetial or stem leaves and reaching a length of 10 mm., rarely 15 mm., from which arise the fruiting branches the following year when they have become decumbent and rooting; upper stem leaves clasping, lanceolate, channelled, and subulate, reaching 1.5 mm. (1 : 5) in length, mostly entire, sometimes serrulate, gradually reduced below, becoming bract-like and broader (1 : 2); costa percurrent or slightly excurrent, basal cells rectangular and rather regular, about 18 x 60 μ, sometimes longer, the marginal row sometimes made up of shorter and broader, more regularly rectangular cells; median cells more or less prosenchymatous, about 15 x 60 μ, some lower ones reaching 100 μ (1 : 8) in certain plants; perichaetial leaves much larger reaching 0.6 x 2.6 mm. (1 : 4–5), lanceolate or ovate-lanceolate, entire or slightly serrulate; costa percurrent or moderately excurrent; basal cells more or less rectangular, usually around 80 μ long (1 : 5–6), sometimes reaching 140 μ long; median cells more or less prosenchymatous, usually about 70 μ (1 : 5–7) sometimes reaching 100 μ in length. Paroicous: antheridia and archegonia in the same cluster, but not mixed, the antheridia in the axils of the perichaetial leaves below the archegonia, naked or with 2 small bracts: capsules 1 to 3, globose, sessile, each with a short thick seta surrounded by the cup-shaped vaginule from which it easily separates, large, usually 500–540 μ in diameter, sometimes reaching 575 μ; wall thin, breaking irregularly, cells clear or brown toward the apex of the capsule, more or less isodiametric, irregularly 5- to 6-sided, about 40 μ in diameter; calyptra fugacious, small; spores usually about 24, large, yellow, becoming dark, smooth, irregularly tetrahedral or angled, 150–250 μ, usually about 200 μ in greatest diameter; maturing from fall to spring.

Type locality, wet ground, England.

Illustrations:—Dicks. Pl. Crypt. Brit. *pl. 1, f. 2;* Schwaegr. Suppl. **1**[1]: *pl. 10,* **3**[1]: *pl. 205;* Bry. Eur. *pl. 8, 637;* A. Gray, Man. (Ed. 2) *pl. 1* (as *A. ohionense*); G. Roth, Aussereur. Laubm. **1:** *pl. 11, f. 3, 7;* Limpr. Laubm. **1:** *f. 58, 55;* Braithw. Brit. Moss Fl. **1:** *pl. 14A;* Dixon & Jam. Handbk. Brit. Mosses (Ed. 3) *pl. 7E; Pl. 14C, Pl. 18A.*

Exsiccati:—Drumm. Musc. Am. S. States 11 (as *A. phascoides*, type material for *A. tenerrimum* Mitt.), 12 (as *A. phascoides* var. 2); Aust. Musci Appal. Suppl. 454 (as *A. tenerrimum*); Holz. Musci Acro. Bor. Am. 76 (as *A. Ravenelii*), 453.

Terrestrial; old fields, pastures, etc.; Eastern United States, New York to Florida and westward to Louisiana and Texas, also in northern and central Europe.

2. Archidium longifolium Lesq. & James, Proc. Am. Acad. **14:** 134. 1879.

Plants comparable to *A. alternifolium*, but the more tenuous stems with longer narrower leaves give this moss a far different aspect. As in the preceding species, not at all capitate, the leaves gradually becoming shorter below; stem leaves up to 1.6 mm. long (1 : 7–10), lanceolate, subulate, progressively shorter and broader below, almost entire; costa excurrent; basal cells more or less rectangular, averaging about 70 μ in length (1 : 7); median cells somewhat flexuous-prosenchymatous, up to 100 μ in length (1 : 10–12); perichaetial leaves lanceolate-subulate, reaching 0.36 x 2.5 mm. (1 : 7), entire. strongly echlorophyllose below; costa frequently long-excurrent; basal cells more or less rectangular, mostly 14 x 70 μ, some reaching 105 μ in length; median cells 9–10 x 100 μ, flexuous-prosenchymatous. Paroicous: the gametangia, capsules, and spores have the same characters as the preceding species.

Type locality, Florida. A. P. Garber, 102. 1878.

Illustrations:—Roth, Aussereur. Laubm. **1:** *pl. 11, f. 11; Pl. 15B.*

Exsiccati:—Verdoorn, Musci Selecti Crit., Ser. II (1935) 54; Holz. Musci Acro. Bor. Am. 454; R. & C. Musci Am. Sept. 353.

In meadows and siliceous sands, Florida.

3. Archidium ohioense Schimp. (Bry. Eur. fasc. 43: Archid. 3; hyponym. 1850) C. Muell. Syn. **2:** 517. 1851.

Plants small, seldom over 5–10 mm. high, branching by subapical innovations, light yellow to dark, moderately or not all capitate; stem leaves lanceolate-subulate, mostly 0.7 mm. long, occasionally 1.3 mm. long (1 : 4), shorter and broader below, becoming greatly reduced, appressed-ascending; costa ending in

the subulate tip or excurrent; margins more or less serrulate; basal cells oblong-rectangular, about 35 μ long (1 : 2–4), marginal cells larger and more regular; median cells rhomboidal, about 50 μ in length (1 : 4), sometimes longer, more narrow, and irregularly shaped, especially above; perichaetial leaves longer and broader, 1–1.5 mm. in length, lanceolate to ovate-lanceolate, acuminate, serrulate, especially above and on the acumination; costa percurrent or shortly excurrent; basal cells oblong-rectangular, 35–40 μ long with a fairly definite border of rectangular cells; median cells more or less rhomboidal, mostly about 55 μ long (1 : 5), reaching 70 μ in length above. Gonioautoicous; antheridia on basal fruiting stems in small axillary buds with 3 or 4 ecostate bracts; perigonial leaves, about 0.3 mm. long (1 : 2); capsules 1 to 8, usually 2 or 3, in axillary buds, spherical, 250–325 μ in diameter, walls thin, cells hexagonal, about 20–30 μ in diameter; spores usually about 24, angular or irregularly tetrahedral, deep yellow or orange when mature, smooth or sometimes faintly granulate, 145–175 μ in diameter, maturing from fall to spring.

Type locality, Harper's Ferry, Virginia.

ILLUSTRATIONS:—Sull. Icones Musc. *pl. 7;* Roth, Aussereur. Laubm. **1:** *pl. 11, f. 2; Pl. 15C, 16C.*

EXSICCATI:—Drumm. Musc. Am. S. States 13 (as *A. phascoides* 13, var. 3); Sull. Musci Allegh. 213 (as *A. phascoides*, the type for *A. ohioense*); Sull. & Lesq. Musci Bor. Am. 28, (Ed. 2) 35; Aust. Musci Appal. 44; Holz. Musci Acro. Bor. Am. *2*, 476 (as *A. Donnellii*); Grout, N. Am. Musci Perf. 202.

In fields, meadows, and bare places, Quebec, Minnesota to New York, southward to Florida and westward to Texas.

4. ARCHIDIUM FLORIDANUM Aust. ms., n. sp.

"Stems subflexuous, ¾–1 in. long. Leaves shiny, green, half erect, scarcely changing upon drying, narrowly lanceolate, nearly entire, cells laxish, costa percurrent or excurrent. Male fl. small, axillary, female fl. terminal becoming lateral.—Differs from *A. tenerrimum* chiefly in its axillary male fl., longer stems, lower leaves longer, cells narrower, etc.—Differs from *A. ohioense* in longer stems, more spreading leaves with a lighter less excurrent costa. (Probably not confused with the Ohio plant. C. F. A. Nov. 29, 1878.)" From a manuscript in Austin's herbarium, wherein he proposes the name "Floridanum," which he did not publish. Austin's description was from a collection by J. D. Smith, Indian Pass, Florida, March 4, 1878, which should be designated as the type. An annotation by Mrs. Britton reads, "This looks like *A. ohioense*," April, 1907. The following description from the type material indicates the specific rank of the plant:

Caulis subflexuosus, 1.5–2 cm. longus, non capitatus; folia caulis non conferta, anguste lanceolata, subintegra, ± 1.4 mm. longa (1 : 5–7); cellulis in basi rectangulis, 35–75 μ longis (1 : 2–4); mediis anguste prosenchymatis, 12 x 80 μ (1 : 6–7 vel 1 : 10); folia perichaetialia 1.5 mm. longa (1 : 4); cellulis basilaribus latoribus; mediis 85–100 μ longis (1 : 6–7), anguste rhomboidibus vel prosenchymatis. Flores gonio-autoici; capsulae 2, globosae, 430–540 μ latae, sporis 24, laevibus, flavis, 180–210 μ.

Stems subflexuous, usually about 1.5 cm. long, sometimes 2.0 cm.; not at all capitate, stem leaves not crowded, spreading to ascending, little changed in drying, narrowly lanceolate, channelled, nearly entire, usually about 1.4 mm. long (1 : 5–7); basal cells 35–75 μ long (1 : 2–4), rectangular; median cells narrowly prosenchymatous, 12 x 80 μ (1 : 6–7), some 1 : 10; perichaetial leaves about the same length as the stem leaves, 1.5 mm. long (1 : 4), (short for the genus and without the usual contrast in length between the stem and perichaetial leaves); basal cells shorter, broader, and more regularly rectangular; median cells 85–100 μ long (1 : 6–7), narrowly rhomboidal to prosenchymatous. Gonioautoicous; gametangia as for *A. ohioense* except cells of the perigonial bracts are somewhat larger: capsules usually 2, spherical, 430–540 μ in diameter, wall thin, cells irregularly hexagonal, 20–30 μ in diameter; spores about 24, smooth, yellow, 180–210 μ in greatest diameter. Spores in spring.

Type locality, Indian Pass, Florida.

ILLUSTRATIONS:—*Pl. 15A.*

Sandy soil, known from Indian Pass, Sanford and Caloosa, Florida.

5. ARCHIDIUM DONNELLII Aust. Bull. Torr. Club. **6:** 190. 1877.

Archidium ohioense Donnellii Lesq. & James, Man. 50. 1884.

Plants gregarious in yellowish masses, strongly capitate; stems seldom more than 5 mm. high, branching by subapical innovations; fruiting branches leafless below or with leaves rapidly reduced in size below to mere bracts; stem leaves lanceolate-subulate, broadly lanceolate below, almost entire, frequently about

0.7 mm. long (1 : 4) but reaching 1.5 mm., 1 : 2–3 below; costa percurrent, sometimes short-excurrent; basal cells small, rectangular, 1 : 2–4; median cells narrowly rhomboidal to prosenchymatous, seldom 70 μ long; perichaetial leaves ovate-lanceolate, acuminate, reaching 2.1 mm. in length (1 : 4–5), conspicuously longer than the stem leaves, entire, costa excurrent; basal cells rectangular-oblong to quadrate, short and broad; median cells flexuous-prosenchymatous, 8 x 70 μ (1 : 8–10), reaching 90 μ in length. Cladautoicous: antheridia terminal on a slender branch; perigonial leaves costate: capsule immersed, 250–390 μ in diameter, walls thin, cells hexagonal, 25–35 μ in diameter; spores 12–24, smooth, yellow, heavy-walled, not conspicuously angled, 140–160 μ in greatest diameter, rarely as small as 115 μ or as large as 210 μ, maturing in spring.

Type locality, Hampden Sidney College, Prince Edward Co., Virginia. J. D. Smith, April, 1877.

Illustrations:—Roth, Aussereur. Laubm. **1:** *pl. 11, f. 6; Pl. 14A.*
Exsiccati:—Aust. Musci Appal. Suppl. 455.
Terrestrial, from Maryland to Virginia, South Carolina and Florida.

6. Archidium Hallii Aust. Bull. Torr. Club **6:** 145. 1877.

Plants gregarious in pale yellow tufts, strongly capitate, leaves longer and crowded at the apex of the stem, not over 5 mm. high with slender subapical branches; stem leaves lanceolate, usually not over 1 mm. long (1 : 3–4), entire, with costa percurrent; lower leaves shorter and broader, ovate-lanceolate, 1 : 2.5; basal cells rectangular, up to 17 x 78 μ but mostly shorter; in the lower leaves, quadrate to rectangular, 35–45 μ in length; median cells rhomboidal to prosenchymatous, 14–70 μ (1 : 5) for upper leaves, becoming about half that size toward the apex of the leaf; smaller in lower leaves, 17 x 35 μ, rhomboidal to oblong-rectangular; perichaetial leaves reaching 2.6 mm. in length (1 : 6) but many are shorter and broader, 0.7 x 2.1 mm.; basal cells rectangular-oblong, echlorophyllose, reaching 17–20 x 110–120 μ, but mostly shorter; median cells irregularly rhomboidal-prosenchymatous, 16 x 80 μ (1 : 5), one collection with cells 26 x 110 μ; upper cells rhomboidal, 50 μ long (1 : 3–4). Cladautoicous as in *A. Donnellii;* capsule terminal or thrust aside by the branches, 360–500 μ in diameter; spores about 30, smooth, yellow, angular, about 210 μ in greatest diameter, maturing in spring.

Type locality, Houston, Texas. E. Hall.

Illustrations:—Roth, Aussereur. Laubm. **1:** *pl. 10, f. 1, 2; Pl. 14B.*
Terrestrial, Florida to Texas.

6a. Var. minus Ren. & Card. Bot. Gaz. **19:** 237. 1894.

Plants minute, only 1–2 mm. high, pale yellowish; stem leaves small, not over 1.0 mm., lanceolate, costa usually ending below the apex; perichaetial leaves not over 1.4 mm. (1 : 4); basal cells rectangular, 26 x 52 μ; median cells rhomboidal-oblong, 50–70 μ long (1 : 3–4), some lower median cells reaching 100 μ. Cladautoicous as in the species; capsules smaller, not over 360 μ; spores about 24, smaller, usually about 125 μ in greatest diameter and not over 140 μ, distinctly and continuously granular, which, together with size, seems to constitute a good diagnostic difference, maturing in the fall.

Type locality, Mandeville, Louisiana. A. B. Langlois, 1892.

Illustrations:—*Pl. 18B.*
Collected on soil only from Tehiffonte and Mandeville, Louisiana.

Family DITRICHACEAE.

Plants gregarious to densely cespitose and matted with radicles; stems often branching by innovations, mostly less than 2 cm. high; leaves various, usually subulate from a broader base, which is often sheathing; costa mostly percurrent to excurrent and forming a large part of the awn, which may be rough or smooth; leaf cells smooth, larger and more elongated at the base, alar cells not enlarged; calyptra beaked, mitrate or cucullate; capsules cleistocarpous or with a dehiscent operculum and peristome (which is typically of 16 slender teeth divided nearly to the base into two filiform divisions, sometimes irregularly divided and perforate) erect and symmetric or inclined and unsymmetric, ovoid, cylindric, pyriform, or with a very long neck; annulus usually present and large.

KEY TO THE GENERA.

1.	Capsule cleistocarpous, dehiscing irregularly and without peristome	2.
	Capsule with operculum and peristome	3.
2.	Capsules ovoid, beaked, immersed	*1. Pleuridium.*
	Capsules pyriform or long-necked, immersed to long-exserted	*2. Bruchia.*
3.	Capsule with a slender neck as long as the urn or much longer	*3. Trematodon.*
	Capsule without obvious neck	4.
4.	Leaves distinctly 2-ranked, with sheathing bases	*4. Distichium.*
	Leaves not 2-ranked	5.
5.	Leaves whitish with a glaucous bloom	*6. Saelania.*
	Leaves without bloom	6.
6.	Capsules strongly sulcate, slightly strumose	*5. Ceratodon.*
	Capsules (except *D. pallidum* and *D. Schimperi*) not sulcate	*7. Ditrichum.*

1. PLEURIDIUM Brid. Musc. Recent. Suppl. **4**: 10. 1819.

Plants annual or perennial, usually in low dense light- to yellowish-green sods; stems mostly 5 mm. high or less, simple or branching by innovations; central strand present; leaves spreading, erect or the upper secund, not crisped or contorted when dry, small and distant below, longer and crowded above; upper and perichaetial mucronate to long-subulate from an ovate to lanceolate base, entire or minutely serrulate above; costa broad, poorly defined at base, broad and thick above, nearly or quite filling the subulate apex, often rough on the back, in cross section showing 6–12 large guide cells in a row, bordered above and below with narrow stereid bands. Monoicous; capsules immersed on a very short seta, sometimes appearing lateral because of innovations, ovoid to subglobose, short-apiculate with a rather blunt point; calyptra cucullate in our species (except *P. palustris*), covering scarcely ½ the capsule; cleistocarpous without trace of operculum or peristome; spores finely or coarsely papillose. Type species *P. subulatum* (Hedw.) Lindb. (*P. alternifolium* Brid.). Distinguished from *Bruchia* by the lack of neck to the capsule; from *Archidium* by the smaller, much more numerous spores; from other cleistocarpous mosses by the narrow, non-contorted leaves not papillose except at or near the apex.

KEY.

1.	Calyptra mitrate; immersed stomata in the middle of the capsule wall	*7. palustre.*
	Calyptra cucullate, split almost to the apex; stomata basal	2.
2.	Broad leaf base much less than ½ the length of the upper and perichaetial leaves (*Ravenelii* may be sought here)	3.
	Broad leaf base nearly equal to or longer than the rest of the leaf	5.
3.	Median and upper cells of leaf base rectangular to oblong, 2–4 : 1 (*Bolanderi* may be sought here)	4.
	Median and upper cells of leaf base linear, 5–8 : 1	*2. acuminatum.*
4.	Perichaetial leaves entire at base; awn mostly smooth at back; plants of the Pacific Coast	*3. Bolanderi.*
	Perichaetial leaves more or less serrulate at base; awn rough at back; plants of the eastern U. S.	*1. subulatum.*
5.	Awn of perichaetial leaves much less than ½ their length	*5. Sullivanti.*
	Awn of perichaetial leaves nearly or quite equal to ½ their length	6.
6.	Awn of stem leaves nearly or quite smooth on the back; marginal cells of leaf base not shorter than the median	*4. Ravenelii.*
	Awn rough on the back; marginal cells of leaf base shorter and more distinct than the median	*6. californicum.*

1. PLEURIDIUM SUBULATUM (Hedw.) Lindb. Öfvers. Vet.-Akad. Förh. 408. 1863.

Phascum subulatum Schreb. de Phasco 1770; Hedw. Stirp. Crypt. **1**: 93. *pl. 35.* 1787, and Sp. Musc. 19. 1801. (not of Hudson, Fl. Angl. 1762).

Pleuridium alternifolium (Dicks.; Kaulf.) Rabenh. Deutschl. Krypt. **2**^{3}: 79. 1848 and Bry. Eur. 1850.; Brid. Musc. Recent. Suppl. **4**: 10. 1819.

Plants in close yellow-green sods; stems mostly simple, 2–5 mm. high, in damp places frequently with decumbent innovations up to 1 cm. or more; lower leaves distant, somewhat spreading, lanceolate-subulate 0.5–1.5 mm. long, the upper longer and more crowded; upper and perichaetial leaves long subulate-acuminate from an ovate or lanceolate base about ⅓ the length of the leaf, 3–4 mm. long, erect-spreading to subsecund, with the awn more or less roughened and often serrulate on the edges; costa strong, often filling ⅓ the base and all the apex, in cross section with 6–10 large central guide cells and a narrow band of stereid cells above and below; antheridia in axillary buds or rarely naked in the axils of the upper and perichaetial leaves; cells of the upper base of the perichaetial leaves rectangular to oblong-hexagonal, 6–10 μ wide 3–4 : 1 nearly or quite to the shoulder, narrowed and linear above; occasionally the inner perichaetial leaves have the costa very slender at base. Seta very short, 0.4–1 mm. long; capsules ovoid, about 1 mm. long, abruptly apiculate, with a blunt point, stomatose at base; calyptra cucullate; spores finely and densely papillose, reaching 28 μ, mature in late spring to early summer.

Type locality, Saxony.

Illustrations:—Bry. Eur. *pl. 10;* Braithw. Brit. Moss Fl. **1:** *pl. 14A;* M. H. M. *f. 32;* Mosses with a Hand-lens (Ed. 3) *pl. 18c; Pl. 13 C, f, 1, 2.*

Exsiccati:—So far as examined all the American exsiccati issued as this and the next, except as cited under the next species, are *P. subulatum* (Hedw.) Lindb. [*P. alternifolium* (Kaulf.) Rabenh.]. In many cases careful search has failed to detect antheridia in axillary buds or naked in the leaf axils. Lacking antheridial buds the surest means of identification of this species are the broader and shorter leaf cells of the perichaetial leaves and the much more frequent innovations from the upper leaf axils.

2. Pleuridium acuminatum Lindb. Öfvers. Vet.-Akad. Förh. **1863:** 406. 1863.

Pleuridium subulatum (Huds.) Rabenh. Deutschl. Krypt-Fl. **2**[3]**:** 79. 1848; not *Phascum subulatum* of Schreb. 1770 or Hedw. 1787 and 1801.

Differs from the preceding in the usually shorter plants, the lack of slender innovations, the leaf base longer and more gradually narrowed to the subulate awn, the narrower (few over 7 μ wide) and longer (up to 75 μ) cells of the upper median portion of the base of the perichaetial leaves, and the less roughened awn. Spores mature March to April.

Type locality, England.

Illustrations:—Bry. Eur. *pl. 9;* Braithw. l. c. *pl. 14C;* M. H. M. *f. 31; Pl. 13C, f. 3, 4.*

Exsiccati:—Drumm. Musc. Am. S. States 7; Sull. Musc. Allegh. 31b; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 39 in part; Grout, Musci Perf. 25 (the S. Carolina plants only, the original issue is *P. subulatum* (Hedw.) Lindb.

Few of the northern plants studied seemed to be this species and it seems less frequent in North America than the preceding. Sandy fields, Massachusetts to Georgia and Alabama; also in California. A few plants from the northern U. S. and some from the South Atlantic States match the European very closely. The long broad leaf base reminds one of *P. Ravenelii*, but in that species the leaf base is from ½–⅔ the length of the perichaetial leaves, while in *subulatum* it is rarely over ⅓ the length. The base of the perichaetial leaves is sometimes slightly toothed near the base of the awn in both European and American plants, but not so distinctly as in *Ravenelii.*

The confusion in the nomenclature of these two species shows that most authors of the 19th century and earlier did not have a clear idea of their relationship.

3. Pleuridium Bolanderi C. Muell.; Jaeger, Ber. St. Gall. Nat. Gesell. **1868–1869:** 91. 1869.

Pleuridium stramineum Lesq.; Aust. Bull. Torr. Club. **6:** 142. 1877.
Pleuridium alternifolium Howei R. & C. Rev. Bryol. **20:** 30. 1893.
Pleuridium Bakeri Card. & Thér. Bot. Gaz. **37:** 363. 1904.

Stems simple [rarely with slender innovations (*P. alternifolium Howei*)]; lower leaves lanceolate, small, 0.5–1 mm. long, sometimes obscurely serrulate; upper and perichaetial leaves 2–4 mm. long, erect-spreading, somewhat secund, long subulate-acuminate from an entire lanceolate base less than ½ the length of the leaf; cells of the upper median leaf base oblong to linear, narrower at margin; costa slightly toothed at the apex, broad and ill defined at base, filling nearly the entire upper awn, which is channelled by the incurved margins below, with 9–10 large central guide cells. Antheridia few in small buds in and near the perichaetium; seta 0.4–0.7 mm. long; capsule ovoid, about 1 mm. long; exothecial cells thin-walled, hexagonal, little longer than broad; spores 21–30 μ in diameter, coarsely papillose, mature in early spring.

Type locality, Oakland, California.

ILLUSTRATIONS:—Bot. Gaz. l. c. *pl. 16; Pl. 17B.*
EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 39, in part; Holz. Musc. Acro. Bor. Am. 329; Baker, Pacific Slope Bryophytes 295, 568; (all except the first as *P. Bakeri*).

On soil, California to Washington. Near *P. acuminatum* and perhaps better regarded as a subspecies or variety distinguished by the entire margin and smoother awn of the perichaetial leaves. The upper cells of the leaf base are also relatively broader and shorter as a rule. Occasional plants on a more elevated portion of the substratum will have very short awns, scarcely longer than the leaf base (Mrs. MacFadden, no. 9412 from Calif.), while other plants are quite normal.

4. PLEURIDIUM RAVENELII Aust. Bull. Torr. Club. **6:** 142. 1877.

Stems erect, mostly simple, 1–3 mm. high; leaves loosely incurved when dry, the lower smaller and appressed, the upper and perichaetial 1–2 mm. long, concave, tapering from an ovate-lanceolate base to a subulate, canaliculate awn ± the length of the base; margins incurved, more or less serrulate on the upper blade and the awn; costa broad, poorly defined below, nearly filling the awn, percurrent to excurrent, in cross section with 3–5 large guide cells with narrow stereid bands above and below; median and upper leaf cells of blade narrowly oblong to linear, 7–10 μ wide, 5–7 : 1, not shorter at the margin. Paroicous, antheridia naked in the axils of the upper leaves or with a few small bracts; seta about 0.25 mm.; capsules immersed, ovoid to subspherical, yellowish, shortly and bluntly apiculate, 0.5–0.8 mm. long; spores coarsely papillose, 30–37 μ in diameter, maturing March to June.

Type locality, South Carolina.

ILLUSTRATIONS:—Roth, Aussereur. Laubm. **1:** *pl. 16, f. 2; Pl. 16A.*
EXSICCATI:—Aust. Musc. Appal. Suppl. 457 (type); Holz. Musc. Acro. Bor. Am. 473.

On light sandy soil with little other vegetation; Massachusetts to South Carolina. Apparently rare.

Most likely to be confused with *P. acuminatum* from which it is distinguished by the larger spores and relatively longer and more strongly serrate leaf base. The basal cells are similar in most of our species, large and loosely oblong, at times almost inflated, but above the middle of the leaf base the cells are characteristic.

5. PLEURIDIUM SULLIVANTI Aust. Bull. Torr. Club **6:** 142. 1877.

Phascum nervosum Sull., in Gray, Man (Ed. 2) 616. 1856. Not of Hook. 1820.
Pleuridium nervosum Sull. Icones Musc. 19. *pl. 10.* 1864. Not of Hook. & Wils. 1854.

Plants yellowish-green; stems flexuose-erect, *often with slender julaceous sterile flagella-like branches,* 2–4 mm. high; leaves appressed, imbricate, the upper and perichaetial 1.5–2 mm. long, *ovate to oblong, abruptly long-mucronate with a smooth point shorter than the broad serrate basal portion;* lower leaves much smaller, gradually acuminate; costa in the upper leaves stout, broadest at the base of the awn; cells of the upper leaf blade linear, about 7 μ wide, 5–8 : 1, rather thick-walled, the cells below these larger, looser and thinner-walled. Autoicous; antheridia in buds in the axils of the lower leaves; seta about 0.25 mm. long; capsule ovoid to subglobose, less than 1 mm. long, short-apiculate, immersed, often bright orange; spores coarsely papillose, reaching 30 μ in diameter, mature March–April.

Type locality, Pennsylvania.

ILLUSTRATIONS:—Sull. l. c.; *Pl. 17A.*
EXSICCATI:—Drumm. Musc. Am. S. States 6; Aust. Musc. Appal. Suppl. 458.

On light bare soil, often among stones; Connecticut to Florida; rare. Perhaps the most clearly differentiated of all our species.

6. PLEURIDIUM CALIFORNICUM **n. sp.**

Plantae gregariae, humiles, 1–3 mm. altae; folia superiora et perichaetialia e basi lanceolata sensim in subulam breviorem basi producta; basis superior serrata; costa lata, percurrens vel excurrens; capsula ovata, minus 1 mm. longa; sporis 30–37 μ metientibus.

Plants small, gregarious; stems reaching 2–3 mm. long, often shorter, mostly simple; upper and perichaetial leaves 1–1.5 mm. long, gradually subulate from a lanceolate base; *awn much shorter than the broader basal portion, channelled, serrate and rough on the back;* basal portion serrate above, more or less roughened on the back, margins incurved; costa stout, constituting most of the awn, percurrent to excurrent, poorly defined; leaf cells of the upper blade, rectangular to oblong-linear, indistinct except near the margin, apparently in more than one layer, marginal shorter, about 2 : 1; lower leaves smaller. Seta about 0.5 mm. long; calyptra small, cucullate; capsule ovoid, less than 1 mm. long, with a relatively short stout apiculus; spores 30–37 μ, coarsely papillose, maturing in spring. *Pl. 16B.*

Type locality, foot hills, Altadena, California (C. C. Kingman, March 23, 1911), Holz. Musc. Acro. Bor. Am. 330 (as *P. Bolanderi*). Nearest to *P. Ravenelii* but easily distinct by the characters noted in the key.

7. PLEURIDIUM PALUSTRE (Br. & Sch.) Bry. Eur. fasc. 43. *pl. 10.* 1850.

Phascum palustre Br. & Sch. Mém. Soc. Hist. Nat. Strasb. **2**: 2. *pl. A.* 1835.
Phascum uliginosum Hüben.; Gent., Fl. Nass. 146. 1836.
Astomum palustre Hampe, Flora **20**: 285. 1837.
Bruchia palustris C. Müll. Syn. **1**: 19. 1848.
Sporledera palustris Hampe, Schimp. Coroll. Bry. Eur. 6. 1855.

Stems simple or branching by innovations, 1–2 mm. high, rarely more; upper and perichaetial leaves 2–4 mm. long, long linear-subulate from a broader ovate to lanceolate base; awn rough, channelled, *several times the length of the base;* lower leaves smaller; costa stout, excurrent, in cross section showing 2–6 large guide cells with a few stereid cells above and below; cells of upper and median leaf base rectangular to oblong-hexagonal, 7–15 μ wide, 2–3 : 1, rather thin-walled, narrower at the margin. Paroicous; antheridia in the axils of the upper leaves; seta less than 0.5 mm. long; *calyptra mitrate,* 4–5 lobed, rarely entire; capsule sometimes appearing lateral by reason of innovations, ovoid, reaching 1 mm. in length, *with a relatively long and sharp apiculus; stomata immersed, in the middle or upper capsule wall;* spores finely papillose, reaching 30 μ in diameter; maturing May–June.

Type locality, France.

ILLUSTRATIONS:—Bry. Eur. l. c.; *Pl. 18B.*
EXSICCATI:—Drumm. Musc. Am. S. States 8; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 40; Aust. Musc. Appal. 55; Grout, Musci Perf. 279.

In wet fields and sandy swamps; Massachusetts to Tennessee; also in central Europe; rare.

2. * BRUCHIA Schwaegr. Suppl. 2^1: 91. 1824.

Saproma Brid. Bryol. Univ. **1**: 52. 1826.
Sporledera Hampe, Linnaea **11**: 279. 1837.

Protonema mostly persistent; plants gregarious, small but usually fruiting freely; stems short and simple, with a central strand; the crowded leaves at the top of the stems larger than the more distant lower leaves; mostly long-subulate from a broader ovate to lanceolate base, erect to somewhat secund; costa stout, ending below the apex or excurrent into the subulate upper part, in cross section with thick outer cells, stereid cells and a few guide cells; leaf cells smooth or papillose, rectangular at base; perichaetial leaves usually larger and more sheathing. Autoicous or paroicous, occasionally dioicous; antheridia axillary or in basal buds. Seta shorter or occasionally longer than the perichaetial leaves; capsules obovoid to pyriform, indehiscent, sharply pointed above, the upper part often colored, neck with numerous large stomata, shorter than the spore sac; calyptra mitrate, lobed, smooth or papillose, covering ⅓ or more of the capsule; spores spinose to warty, or reticulated to pitted, maturing spring to early summer.

Type species, *B. vogesiaca* Schwaegr.

KEY.

1. Capsules immersed to fully exserted; neck of capsule never much exceeding the length of the rest of the capsule ..... 2.
   Capsules long exserted; neck much longer than the rest of the capsule as in *Trematodon;* very rare ..... 12.
2. Calyptra papillose to spinose; seta shorter than the capsule ..... 3.
   Calyptra smooth ..... 4.
3. Spores reticulate ..... 9. *Ravenelii.*
   Spores pitted ..... 10. *Carolinae.*
4. Stems very short, scarcely longer than the leaves or capsule; seta shorter than the capsule (except forms of *Sullivantii*) ..... 5.
   Stems longer; seta mostly longer than the capsule ..... 9.

* Mrs. Britton's Monograph in the North American Flora 15^1: 46–51 has been freely consulted and often followed.

5.	Leaves rounded-obtuse, nearly as broad as long; costa slender, ending below the apex; spores pitted	*7. fusca.*
	Leaves subulate above; costa subpercurrent to excurrent	6.
6.	Leaf apex rough; upper cells papillose	*3. Donnellii.*
	Leaf apex nearly or quite smooth, sometimes slightly toothed on the margin; upper cells smooth	7.*
7.	Neck shorter than the rest of the capsule (forms of *brevifolia* may be sought here)	8.
	Neck equal to or longer than the rest of the capsule; spores pitted	*7. brevifolia.*
8.	Perichaetial leaves longer than seta and capsule	*8. Drummondii.*
	Perichaetial leaves shorter than capsule and seta	*1. Sullivanti.*
9.	Leaves short-acuminate	*5. Hallii.*
	Leaves long-subulate	10.
10.	Subulate leaf apex very rough on the back; upper blade cells papillose	*3. Donnellii.*
	Subulate leaf apex smooth, or slightly roughened, or slightly toothed	11.
11.	Neck less than ½ the length of the capsule; spores spinose	*2. flexuosa.*
	Neck reaching ½ the length of the capsule; spores reticulate	*4. texana.*
12.	Known from New Hampshire only	*12. longicollis.*
	Known from California only	*11. Bolanderi.*

1. BRUCHIA SULLIVANTI Aust. Bull. Torr. Club **6**: 143. 1877.

Bruchia flexuosa Sull. in A. Gray, Man. 645 (in part). 1848. (Not *B. flexuosa* C. Muell. 1847.)

Plants usually densely gregarious and freely fruiting; stems very short, or sometimes taller and reaching 2 mm. long; lower leaves of longer stems small and distant, upper crowded, 1–2 mm. long, abruptly subulate-lanceolate from an ovate base; costa strong, broader above, slight-roughened, nearly filling the subulate apex; margins entire or sparingly serrulate; basal cells laxly rectangular, gradually smaller and more irregular upwards, all smooth, in the upper blade short-rectangular to irregularly polygonal, about 8 μ wide, narrower at the margin; perichaetial leaves nearly or quite reaching base of capsule. Autoicous; antheridia in lateral or basal buds. Seta 1–2 mm. long; calyptra nearly or quite smooth; capsule pyriform, 1–1.5 mm. long, brown to yellowish, beak straight, *neck about the length* of *spore sac*, with numerous stomata; *spores densely spinose*, 30–40 μ in diameter, June–July.

Type locality, Closter, New Jersey.

ILLUSTRATIONS:—Sull. Icones Musc. *pl. 13; Pl. 19B.*

EXSICCATI:—Drumm. Musc. Am. S. States 14 (as *B. vogesiaca*); Aust. Musc. Appal. 56 (as *B. flexuosa*); Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 41, in part (as *B. flexuosa*); Holz. Musc. Acro. Bor. Am. 1 (as *B. flexuosa*), 52 (as *B. curviseta*), 201 (as *B. Donnellii*).

Moist soil in fields, often among grasses and weeds; Maine to Minnesota, south to the Gulf; our most common species.

* 2. BRUCHIA FLEXUOSA (Sw.) C. Muell. Bot. Zeit. **5**: 99. 1847.

Phascum flexuosum Sw. Adnot. Bot. 75. 1829.
Sporledera Beyrichiana Hampe, Linnaea **11**: 279. 1837.
Bruchia Beyrichiana Sull. Icones Musc. Suppl. 25. *pl. 15.* 1874.
Bruchia brevicollis Lesq. & James, Man. 47. 1884.

Close to the last and intergrading with it. Probably derived from it though described earlier. Differs chiefly in longer stems; smoother leaf awns and shorter capsules with a much shorter neck, about 1–1.2 mm. long. Antheridia in leaf axils without paraphyses, rarely bracted. The leaves are usually entirely smooth with a few serrations at or near apex.

Type locality, Pennsylvania

ILLUSTRATIONS:—Sull. l. c.; *Pl. 19A.*

EXSICCATI:—Drumm. Musc. Am. S. States 14 (in part), 15 (as *B. vogesiaca* var. 2) in part; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 32, 33 (according to Mrs. Britton l. c.); (Ed. 2) 41, 42; R. & C. Musc. Am. Sept. 1, 1b.

Subspecies of the last and with the same habitat and range.

* See also *B. texana.*

To the author it seems that the no. 33 of Sull. & Lesq. is nearer *B. Sullivanti* as placed in the Lesq. & James Manual p. 46 (*B. Sullivanti* var. *nigricans*). The leaves are the leaves of *Sullivanti* but the capsules are those of *flexuosa*. 32 is decidedly nearer *Sullivanti*, differing only in the slightly shorter neck of the capsule. Grout, Musci Perfecti 240 (as *B. texana*) is a similar form having the leaves of *Sullivanti* but with the neck shorter than in the S. & L. 32.

The length of the seta in *flexuosa*, *Sullivantii* and *Donnellii* seems quite variable depending on maturity, moisture and other soil conditions. I doubt very much if *Sullivanti* and *flexuosa* are distinct species. Plants occur with slender smooth leaves and long-necked capsules; others with short, rough-awned leaves have capsules with short necks. The no. 1 of R. & C. seems to me to be typical of *B. Sullivanti* in all its characters. As the type of *B. flexuosa* has not been accessible, Sullivant's figures have been taken as typical.

*3. Bruchia Donnellii Aust. Bull. Torr. Club. **6**: 144. 1877.

Subspecies of *B. Sullivanti* from which it differs in the much rougher and more contorted leaf awn, papillose upper leaf cells; antheridia naked in upper leaf axils; shorter capsule neck, shorter than the rest of the capsule; spores spinose to spinose-reticulate, with spines joined in irregular groups, sometimes forming irregular lines but rarely any closed areolae, maturing Feb.–April.

Type locality, Rosedale, Florida.

Illustrations:—Bull. Torr. Club. **21**: *pl. 214; Pl. 23B, 13C, f. 6.*

Exsiccati:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 41, in part (as *B. flexuosa*); Aust. Musc. Appal. Suppl. 464; Holz. Musc. Acro. Bor. Am. 352 (his 201 in my set is a form intermediate between *B. flexuosa* and *B. Sullivanti*). On moist soil, S. Carolina to Florida.

This is quite evidently a derivative of *B. Sullivanti* and grades into it. The seta is not always longer than the perichaetial leaves. The capsule is often not more than 1.25 mm. long.

Typical specimens of species 1–3 are distinct enough. *Sullivanti* has capsules with neck as long as the rest of the capsule excluding beak, leaf awn long and somewhat roughened. *Flexuosa* has a neck about ½ the length of the rest of the capsule and leaf awn smooth except for a few serrations at or near the apex. Both 1 & 2 have smooth leaf cells.

Donnellii has very rough leaf awns with upper cells of leaf papillose, neck shorter than *Sullivanti*, longer than *flexuosa*. Between 1 and 2, and between 2 and 3 are numerous plants intermediate in one or more of the above characters. The fact that various species grow intermingled and that many of the exsiccati are mixed adds to the confusion.

The evolution of the areolae on spores of this genus seems indicated in this species and the next two. In this species the spines on the spores of some plants are in irregular groups, in others these groups form wavy lines occasionally inclosing a space (Bauer, Musci Eur. & Am. 2102). In *B. texana* the areolae are all nearly hexagonal with the inclosing ridges papillose on the edges. In *B. Drummondii* these reticulations reach their highest development with areolae more regularly hexagonal. Spores of nos. 1–5 all seem to have one side almost smooth.

4. Bruchia texana Aust. Bull. Torr. Club. **5**: 21. 1874.

Bruchia curviseta Lesq. & James, Man. 47. 1884.

Plants gregarious, varying a great deal in size and length of seta even in the same colony; stems 1–2 mm. high, rarely more; basal leaves smaller, the upper and perichaetial clustered, 1–1.5 mm. long, abruptly and rather broadly subulate from an ovate to lanceolate more or less clasping base, subula of perichaetial leaves mostly shorter than the broad leaf base, sometimes toothed at the apex; *costa very thick and strong, weaker at the base, usually not quite filling the awn, ending below the apex or sometimes percurrent*, occasionally slightly roughened on the back; basal cells oblong, thin walled and lax, 10–15 μ wide, 4–6 : 1, the upper much smaller and shorter, irregular. Paroicous, antheridia in the axils of the upper leaves; seta straight to curved, typically 1–1.5 mm. long and exceeding the perichaetial leaves, but often less than 1 mm. long and shorter than the perichaetial leaves; capsule 1–1.5 mm. long, *bright yellow above when mature, pyriform with a long slender beak, abruptly narrowed to the seta; neck nearly or quite as long as the spore* sac, stomatose, shriveled when dry; *spores reticulate with spinose ridges* and closed areolae, 35–40 μ in diameter, maturing in spring.

Type locality, Houston, Texas (E. Hall); type at the N. Y. Botanical Garden.

Illustrations:—Bull. Torr. Club, **21**: *pl. 213; Pl. 23A, 13C, f. 5.*

Exsiccati:—Drumm. Musc. Am. S. States 15, in part (as *B. vogesiaca* var. 2); Aust. Musc. Appal. Suppl. 463.

On moist soil; Maryland to Illinois, south to Georgia and Texas.

The relative length of seta and leaves seems to be very inconstant in this and the preceding species. In her notes in the Bull. Torr. Club, l. c., Mrs. Britton keeps *curviseta* separate from *texana*, but in the N.

American Flora **15**[1]: 48. 1913, she gives a description of the type form from Texas without mentioning the differences between this and Austin's 463 which she has previously cited as *B. curviseta*. This latter has a much shorter and more curved seta that does not equal the perichaetial leaves in length. The illustration is a good representation of the type.

5. Bruchia Hallii Aust. Bull. Torr. Club **5**: 21. 1874.

Stems 2–3 mm. long, simple, erect; leaves imbricate-appressed when dry, smaller below and rather gradually larger upwards, the perichaetial reaching 1 mm. or more in length, clasping; *all ovate-lanceolate*, the upper relatively broader, *abruptly and shortly acuminate*, entire or nearly so; costa strong, nearly percurrent to very briefly excurrent; basal cells oblong-hexagonal, 7–10 μ wide, 2–4 : 1, narrower at the margins; the upper smaller and more irregular. Paroicous; antheridia in the axils of the upper leaves; seta stout, straight or curved, 1–1.5 mm. long, longer than the perichaetial leaves; capsules light brown, 1–1.5 mm. long, *pyriform with a long beak; neck shorter than the spore sac*, rather gradually narrowed to the seta, shriveled when dry; *spores spinose, large, reaching over 50 μ in the type*, mature in winter.

Type locality, Houston, Texas; type at the New York Botanical Garden.

Illustrations:—Bull. Torr. Club **21**: *pl. 215; Pl. 24A*.

On moist soil. In the herbarium of the New York Botanical Garden is but one specimen other than the type. Evidently rare. Distinguishable even with a hand-lens by reason of the relatively long stems covered with the imbricate leaves, not appearing all bunched at the top as in most species.

6. Bruchia brevifolia Sull. in A. Gray, Man. (Ed. 2) 617. 1856.

Plants small; stems 1–2 mm. high; leaves few, erect or spreading, the upper and perichaetial 1–2 mm. long, from a broad ovate base abruptly narrowed to a rather broad subulate awn ⅓ to ½ the entire length of the leaf; margin entire to subserrulate; *costa very thick, ending in the apex or percurrent;* basal cells oblong-rhomboidal to rectangular, smaller above on the shoulders, irregularly rhombic, about 8 μ wide. Autoicous; *antheridia in basal buds;* seta about 0.5 mm. long; calyptra smooth, covering about ½ the spore sac; capsule relatively large, 1–1.5 mm. long, elongate-pyriform, *bright orange above when mature, apiculate;* neck as long as the spore sac, abruptly narrowed to the seta; *spores pitted, 21–30 μ*, mature in early spring.

Type locality, Louisiana.

Illustrations:—A. Gray, l. c. *pl. 1;* Sull. Icones Musc. *pl. 15; Pl. 20B*.

Exsiccati:—Drumm. Musc. Am. S. States 15, in part; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 34, (Ed. 2) 44; Grout, Musci Perf. 274.

On moist sandy soil, North Carolina to Texas.

Mrs. Britton describes the spores as pitted; to the author they seem rather to be very finely reticulate with thick smooth ridges and small enclosed spaces.

7. Bruchia fusca E. G. Britton, Bull. Torr. Club **21**: 361. 1894.

Plants closely gregarious, brown to yellowish, often growing around stones and pebbles; stems short, 1 mm. or less in height, naked at the base; leaves few, 3–6, erect-appressed, 1 mm. or less in length, often reaching the base of the capsule, *broadly ovate, often broader than long, obtuse to broadly acute*, entire or nearly so, the inner concave and clasping; costa wide and strong in the perichaetial leaves, often faint at base, ending below the apex to percurrent, nearly or quite lacking in some of the lowest leaves; basal cells thin-walled, lax, oblong-hexagonal, 7–10 μ wide, 2–3 : 1, narrower on the margins, smaller, irregular and incrassate above. Autoicous; antheridia in basal buds; seta short, 0.25–0.5 mm. long; capsule large, 1–1.5 mm. long, nearly or quite exserted, obovoid-pyriform, abruptly apiculate, opaque; neck usually somewhat less than ½ the capsule length, abrupt to tapering; spores 21–30 μ in diameter, *pitted*, mature in April.

Type locality, sandy soil, Maryland (J. D. Smith). Type at the New York Botanical Garden, seen and studied.

Illustrations:—Bull. Torr. Club **21**: *pl. 216; Pl. 20A*.

Also collected in N. Carolina. A very rare and distinct species, nearest the last and evidently a derivative of it. The capsules in the illustration are very poorly drawn; the capsule walls are dense and opaque; the shape reminds one of a stratosphere balloon.

8. Bruchia Drummondii Hampe; Jaeger, Ber. St. Gall. Nat. Gesell. **1868–1869:** 97. 1869.

Bruchia brevipes Sull. in A. Gray, Man. (Ed. 2) 617. 1856. (Not of Hook. 1840.)
Bruchia microcarpa Jaeger, l. c. 98, in part. 1869.

Plants gregarious; stems about 1 mm. high; leaves crowded above; perichaetial leaves 2–3 mm. long, from an ovate or ovate-lanceolate base *abruptly narrowed to a narrow channelled awn three times as long,* which is irregular to serrate on the margin and usually smooth at back, mostly extending beyond the capsule, sometimes not quite as long as seta and capsule; costa not quite filling the lower part of the awn; basal cells rectangular hexagonal, reaching 15 μ or more in width, 3–6 : 1; upper cells of lamina smaller, those near the margin much narrower, all smooth. Autoicous; antheridia in basal buds; *seta very short, 0.3–0.5 mm. long;* calyptra smooth; capsule obovate to short-pyriform, apiculate, truncate at base, *orange above, 1 mm. or more in length;* neck about ⅓ the entire capsule length; *spores 38–45 μ, rarely 55 μ in diameter with beautiful large clear hexagonal reticulations about 8 μ in diameter,* maturing March–April.

Type locality, Louisiana.

Illustrations:—Sull. Icones Musc. *pl. 14* (as *B. brevipes*); *Pl. 24B, 13C, f. 7.*
Exsiccati:—Drumm. Musc. Am. S. States 16, in part (as *B. brevipes*); Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 45; Aust. Musc. Appal. Suppl. 462; Holz. Musc. Acro. Bor. Am. 202.
On sandy ground, Virginia to Georgia, Louisiana and Texas. One of our most clearly differentiated species.

9. Bruchia Ravenelii Wils. in A. Gray, Man. (Ed. 2) 617. 1856.

Bruchia Schwaegrichenii Jaeger, Ber. St. Gall. Nat. Gesell. **1868–1869:** 97. 1869, in part.
Bruchia microcarpa Wils.; Jaeger, l. c. 98, in part.

Plants minute; stems less than 1 mm. long, much shorter than the upper leaves, which are 1–2 mm. long, the upper and perichaetial abruptly subulate from an ovate base; costa broad, excurrent into a more or less serrate awn, nearly smooth to spinose-roughened on the back; margins often incurved, more or less serrulate above; basal cells rhomboidal to oblong, mostly 8–10 μ wide, 3–5 : 1, narrower at the margin, much shorter and more irregular on the shoulders; *calyptra bell-shaped, lobed, apiculate and spinose-papillose.* Autoicous, antheridia in basal buds; capsule obovoid-pyriform, nearly or quite 1 mm. long, apiculate, usually not reaching the leaf apices, sometimes emergent when leaves are short, neck mostly shorter than the spore sac; seta much shorter than the capsule; spores pitted when immature, when ripe reticulate with sharp rough edged ridges, with areolae 6–8 μ wide 25–32 μ in diameter, mature in winter.

Type locality, Santee Canal, South Carolina.

Illustrations:—Sull. Icones Musc. *pl. 16; Pl. 21A.*
Exsiccati:—Drumm. Musc. Am. S. States 16, at least in part (as *B. brevifolia*); Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 33b; Aust. Musc. Appal. Suppl. 460; Holz. Musc. Acro. Bor. Am. 353; Grout, Musci Perf. 228. Austin's 461 contains *B. Drummondii* and mature plants of *Ravenelii* with reticulate spores. In Sull. & Lesq. 33b and Holz. 353 the spores are halfway between pitted and reticulate, probably because of immaturity.
Moist sandy soil; S. Carolina to Louisiana and Florida.

10. Bruchia Carolinae Aust. Bull. Torr. Club **6:** 144. 1877.

Bruchia Ravenelii mollis Lesq. & James, Man. 49. 1884.
Bruchia Hampeana Lesq. & James l. c.; not of C. Muell. 1849.

Plants averaging smaller than in the last; differing mainly in the spores which are finely pitted when immature as shown in the figure, but which when mature are reticulate with small areolae, 2–3 μ in diameter and bounded by thick smooth ridges. Mature spores of this species and immature spores of the last look somewhat alike except for the difference in the size of the areolae. In the spores of *carolinae* about 8–10 pits or areolae can be seen across the diameter of the spore while in *Ravenelii* only 3–5 are fully in view.

Type locality, S. Carolina.

Illustrations:—Bull. Torr. Club. **21:** *pl. 217; Pl. 21B and 13C, f. 8.*
Exsiccati:—Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 43 (as *B. Ravenelii*); Grout, Musci. Perf. 229; Verdoorn, Musci Selecti et Critici 6, (as *B. Ravenelii*).
A careful study of the material available shows little constant difference between this species and the last except the spore markings. The spores at the same stage of development are about the same size. The

neck of the capsule is about the length of the spore sac in the type of *Carolinae* and in other specimens examined except Sull. & Lesq. (Ed. 2) 43, in which the capsule shape can not be differentiated from that of *Ravenelii*. In this the spores are fully mature and the pits are almost reticulae with low smooth walls but with as many as ten pits across the spore diameter, which reaches 37 μ. The spores in Grout, Perfecti 229, are immature and smaller and with smaller more shallow pits as in the type. The essential difference between the two species seems to be that the spores of *Ravenelii* when mature are reticulate with lines of irregular height and thickness, the reticulae or spaces larger, 3–5 across the spore diameter. While in *Carolinae* the spores are deeply pitted, the pits with narrow smooth walls, 8–10 reaching across the spore diameter. The leaves of both species vary from an ovate to a lanceolate base, and a rough serrate apex to a nearly smooth entire one.

11. Bruchia Bolanderi Lesq. Mem. Calif. Acad. **1**: 5. 1868.

Plants densely gregarious; stems 1–2 mm. long, simple or branching by basal innovations; leaves crowded, loosely imbricate, small below, gradually increasing in length upwards; lanceolate to laneolate-subulate; costa strong, vanishing in the apex; perichaetial leaves longer, 1–2 mm., flaccid and loosely areolate, clasping, the interior very narrowly lanceolate; leaf cells thin-walled and lax throughout, oblong-hexagonal below, rectangular and 1–3 : 1 above. Autoicous; antheridia in basal buds; seta 2–4 mm. long, straight or flexuose; calyptra small, narrowly conic; capsule 2–3 mm. long, very long-beaked; neck very long, more than equal the rest of the capsule, stomatose; spores finely warty-papillose, 24–27 μ.

Type locality, Westfall's Meadow, alt. 2400 m., near Big Tree Grove, Yosemite Valley, California, the only known locality.

Illustrations:—Sull. Icones Musc. Suppl. *pl. 14; Pl. 22A.*

Mrs. Britton mentions a slight goiter and a differentiated non-deciduous lid on the capsules, neither of which I was able to demonstrate in type specimens. The shape of the capsules is remarkably like that of *Trematodon*. There are a few short cells at the base of the beak but far too high for an operculum.

12. Bruchia longicollis D. C. Eaton, Bull. Torr. Club **17**: 100. 1890.

Very like the preceding; the perichaetial and upper comal leaves are 2–3 mm. long and broader in the middle; costa stronger; seta 4–5 mm. long; capsule 3–4 mm. long with the beak rather narrower and longer; spores 27–35 μ, rough with relatively large irregular warts; mature in July.

Type locality, Jackson, New Hampshire, on decayed log in swamp. The only known locality. Type at the New York Botanical Garden, seen and studied.

Illustrations:—Eaton, l. c. *pl. 101; Pl. 22B.*

3. TREMATODON Mx. Fl. Bor. Am. **2**: 289. 1803.

Plants gregarious to scattered, growing on soil in moist places; stems mostly simple, with a large central strand; leaves more or less crisped when dry in our species, yellowish-green, with a broad clasping base abruptly or gradually tapering into a lanceolate or subulate apex; costa nearly percurrent to excurrent; leaf cells smooth, thin-walled, loosely elongate-hexagonal to rectangular below, above shorter. Autoicous in our species; seta slender, much exserted, yellow, erect or somewhat curved; capsule with a long slender stomatose neck, often longer than the urn, mostly somewhat curved; operculum long-rostrate, as long as the urn; calyptra cucullate; annulus present; peristome present in our species, united below, the 16 teeth entire, perforate or divided nearly to the base, vertically striate on the outer face.

Type species, *T. ambiguus.*

Key.

1. Neck about twice the length of the urn; leaf margins more or less revolute along awn; peristome teeth perforate between the nodes ..... *2. longicollis.*
   Neck about the length of the urn ..... 2.
2. Costa filling the awn, margins not revolute; peristome teeth bifid ..... *1. ambiguus.*
   Costa not filling the awn, margins revolute; peristome teeth entire or slightly perforate at apex ..... *3. brevicollis.*

1. Trematodon ambiguus (Hedw.) Hornsch. Flora **2**: 88. 1918.

Dicranum ambiguum Hedw. Sp. Musc. 150. 1801.
Trematodon acicularis Kindb. Rev. Bryol. **23**: 18. 1896.

Plants gregarious; stems simple or sparingly branched, up to 1 cm. long, erect to ascending, radiculose; leaves abruptly linear-subulate from an ovate or oblong concave sheathing base, 1–2 mm. long, canaliculate above, toothed at extreme apex; costa stout, nearly or quite filling the awn, percurrent; basal leaf cells oblong-hexagonal to rectangular, 10–25 μ wide, 2–5 : 1, thin-walled and pellucid or yellowish, narrower at the margin; shorter and more incrassate above, awn longer than the broad base; perichaetial leaves reaching more than 3 mm. long, awn often shorter than the base. Autoicous; seta bright yellow, 1–3 cm. long; capsule more or less curved, cylindric; urn up to 2 mm. long; neck of equal or greater length, bearing a slight goiter at the base (strumose); operculum long-rostrate, nearly as long as urn; annulus large, revoluble; peristome teeth from a basal, collar-like membrane extending above the capsule mouth, dark red, mostly split nearly to the basal membrane, occasionally perforate between the nodes instead, striate longitudinally on the outer surface, papillose above and on the inside; exothecial cell walls linear-incrassate; spores coarsely rough-warty, about 24 μ in diameter (Limpricht says 24–35 μ), mature in summer.

Type locality, Sweden.

Illustrations:—Bry. Eur. *pl. 96;* M. H. M. *f. 38; Pl. 26B.*

Exsiccati:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 96; Aust. Musc. Appal. Suppl. 475; Macoun, Can. Musci 24; Grout, Musci Perf. 282; Holz. Musc. Acro. Bor. Am. 333.

On soil in old fields and meadows; Newfoundland to Alaska, south to Virginia.

2. Trematodon longicollis Mx. l. c.

Trichodon flexifolius R. & C. Rev. Bryol. **15:** 70. 1888.

Differs from the preceding in the following particulars; the margins of the awn are more or less revolute and the costa does not fill the awn nor extend quite to its apex; the neck of the capsule is fully twice the length of the urn and has a less conspicuous goiter; the peristome teeth are not split but perforate between the nodes in the lower portion; spores mature April–July.

Type locality, sandy places, Carolina.

Illustrations:—Sull. Icones Musc. *pl. 19; Pl. 25.*

Exsiccati:—Drumm. Musc. Am. S. States 55; Sull. Musc. Allegh. 173; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 75, (Ed. 2) 95; Aust. Musc. Appal. Suppl. 476; R. & C. Musc. Am. Sept. 20; Holz. Musc. Acro. Bor. Am. 79; Grout, Musci Perf. 66.

On moist sandy or clayey soil in old fields and ditches; Massachusetts to Florida, Louisiana and Mexico; also in Cuba and Italy. Very common on the sides of drainage ditches in peninuslar Florida.

3. Trematodon brevicollis Hornsch. Flora **2:** 88. 1918.

Leaves ovate to ovate-lanceolate, short-acuminate; costa ending in the apex, which is not toothed; perichaetial leaves longer, abruptly short-subulate. Neck of capsule equaling the urn; stomata imperfect; peristome teeth inserted below capsule mouth, perforate only near the apex; spores 45–60 μ in diameter, maturing in late summer.

Type locality, Austria.

Illustrations:—Bry. Eur. *pl. 95; Pl. 26A.*

Known in North America from Greenland only; found also in the alpine regions of Europe and central Asia.

4. DISTICHIUM Bry. Eur. fasc. 29–30. 1846. (*Nomen conservandum.*)

Cynontodium Hedw. Sp. Musc. 57. 1801.
Swartzia Ehrh.; Hedw. Stirp. Crypt. **2:** 72. 1789.

Plants in dense silky matted tufts; stems slender, dichotomously divided, tomentose, with a large central strand and collenchymatous cells; leaves *two-ranked, spreading and abruptly narrowed to a long linear-subulate awn from a concave sheathing oblong* base; costa comprising most of the awn, entire or serrulate at apex, in cross section with median guide cells, two stereid bands and thickened outer cells. Monoicous; seta long, slender, yellow; calyptra cucullate; capsules cylindric to ovoid, erect to horizontal, operculum conic; peristome teeth not confluent at base, deeply inserted, 8 or 16, irregularly split along the middle or variously torn and perforate; annulus narrow, spores rough.

Type species, *D. capillaceum.*

KEY.

1. Capsule erect, oblong-cylindric and symmetric to ovoid-cylindric ..... *1. capillaceum.*
   Capsule inclined, ovoid and unsymmetric ..... 2.
2. Peristome teeth 16, variously perforate and split ..... *2. inclinatum.*
   Peristome of 8 lobes, made up of 4–6 variously united linear divisions ..... *3. Hageni.*

1. DISTICHIUM CAPILLACEUM (Hedw.) Bry. Eur. l. c. *pl. 193.* 1846.

Cynontodium capillaceum Hedw. Sp. Musc. 57. 1801.
Swartzia montana [Lam.] Lindb. Musc. Scand. 26. 1879.

Plants in dense tufted silky sods reaching 8 cm. or more in thickness; stems 2–8 cm. long, slender, matted together with brown tomentum, decaying below and growing above, repeatedly dichotomous; leaves 2–4 mm. long, the base sheathing, oblong, 1 mm. or more in length, much shorter than the narrowly linear, spreading, rough-papillose awn; basal cells oblong to linear-flexuose, 3–5 μ wide, those of the upper blade much shorter, irregularly elongated-hexagonal, 2–3 : 1. Seta slender, 0.5–2 cm. long; capsule erect or nearly so, oblong-cylindric, with operculum 1–2 mm. long, brown to chestnut when old; annulus large, falling in pieces; peristome teeth 16, red, slender, irregularly divided, often more or less broken and imperfect, sometimes nearly entire, smooth, relatively short; spores 17–20 μ, papillose, mature in summer.

Type locality, France.

ILLUSTRATIONS:—Bry. Eur. l. c.; Braithw. Brit. Moss Fl. **1:** *pl. 15B;* M. H. M. *f. 34.*
EXSICCATI:—Drumm. Musc. Am. 122, 123; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 108, (Ed. 2) 162; Aust. Musc. Appal. Suppl. 485; Macoun, Can. Musci 57; Holz. Musc. Acro. Bor. Am. 58.

Fissures in rocks in cold and subalpine regions; Greenland to Alaska, south to New England, New York, the Great Lakes region, and in the Rocky Mountains to Arizona. Seemingly abundant in suitable habitats. Closely allied to some species of *Ditrichum* but easily recognized by its distichous sheathing leaves with linear spreading points.

2. DISTICHIUM INCLINATUM (Hedw.) Bry. Eur. l. c.

Cynontodium inclinatum Hedw. Sp. Musc. 58. 1801.
Swartzia inclinata Hedw. Stirp. Crypt. **2:** 74. *pl. 27.* 1788.

Plants in dense olive-green tufts 2–4 cm. high, shorter and less silky than the last; leaves less evidently distichous, closer, 2–3 mm. long, broad base relatively shorter, 1 mm. or less in length, ovate to oblong-ovate, awn less spreading when moist; basal leaf cells narrowly oblong-linear, the uppermost of the blade mostly short-rectangular to subquadrate (oblong in perichaetial leaves), all more incrassate and colored. *Capsule inclined and unsymmetric;* peristome *teeth triangular-lanceolate, variously perforate and split,* usually into 3 divisions, rarely with one or two complete divisions, *striolate transversely to obliquely;* spores 30–45 μ in diameter, warty, mature in summer.

Type locality, Upsala, Sweden.

ILLUSTRATIONS:—Bry. Eur. *pl. 194;* Braithw. l. c. *C;* Limpr. Laubm. **1:** 516. *f. 158; Pl. 18C.*
EXSICCATI:—Drumm. Musc. Am. 124; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 108b, (Ed. 2) 162; Aust. Musc. Appal. Suppl. 486; Macoun, Can. Musci 58; Holz. Musc. Acro. Bor. Am. 178 and 561 (as *D. Hageni* Philib.); Grout, Musci Perf. 253.

In similar situations as the last and in cool peat bogs, less common. Greenland and Labrador, south to the St. Lawrence basin, Minnesota, and the mountains of Montana, Utah and northern California.

Sometimes the plants are a dark red-brown throughout except at the growing tips. Holzinger's 561 is a depauperate, dark colored form stunted by cold and other unfavorable conditions. The peristome is typical and does not in the least resemble that of *D. Hageni.*

3. DISTICHIUM HAGENI Ryan; Philibert, Rev. Bryol. **23:** 36. 1896.

In leaf structure and general appearance almost indistinguishable from *D. inclinatum,* but the 8-lobed peristome, deeply inserted, each lobe or tooth of 4–5 or more irregular linear divisions, irregularly branching and irregularly united at the nodes, is quite distinct. If two teeth of *D. inclinatum* should be connected in pairs by irregular cross attachments it would present a fair picture of a tooth of the peristome of *D. Hageni.*

Through the courtesy of Dr. Johannes Lid of the Oslo Museum I have seen cotypes of *D Hageni* from Norway. The plants in this are less than 1 cm. high, but specimens from Greenland, also sent by Dr. Lid, are fully 4 cm. high. Besides the above mentioned material Dr. Lid also sent specimens from New Kent, Ellsmere Land, King Oscar Land, and North Lincoln in Arctic America. In the large Greenland plants the awn of the upper and perichaetial leaves is much longer (reaching 2.5 mm.) than the broad body of the leaf. In the smaller plants of the type and in most leaves of the other collections the awn is equal to or shorter than the broader part. The roughness of the awn varies greatly, even on the same plant, from nearly smooth to strongly papillose. The capsules vary from short-ovoid to oblong-ovoid and are often plicate when dry. *Pl. 13C, f. 9.*

A single plant with this peculiar peristome might be regarded as an abnormal form of *D. inclinatum*, but the considerable number of collections in the arctic regions, all showing this same character, indicates that it is fixed and worthy of specific recognition.

Below is a translation of Philibert's original description of the peristome.

The peristome of *D. Hageni* is made up of a membrane which is divided irregularly into 8 lobes separated by a clearly marked interval, each of the lobes shows on its internal face 4–5 rows of segments, elongated and linear, brownish to fulvous. These outline likewise 4-5 branches. These branches are clearly marked and are sometimes free toward the summit, sometimes entirely adherent to the main part of the lobe, sometimes more or less united, 2 by 2, at their nodes. They may even be enveloped by a sort of hyaline network uniting them to each other. The dorsal aspect is much the same.

Brotherus (Laubm. Fennoskand. 17) says "Kapsel . . . länglich-zylindrisch, symmetrisch." This is not true of any plants I have seen.

5. CERATODON Brid. Bryol. Univ. 1: 480. 1826.

Plants cespitose, more or less matted together below, green to brown, often with a reddish tinge when old; stems with central strand, slender, erect, branching by innovations; leaves erect-spreading, crowded, appressed and somewhat contorted when dry; costa strong, nearly percurrent to excurrent, margins recurved; leaf cells smooth, short-rectangular, more or less rounded at the corners, thick-walled; perichaetial leaves sheathing. Mostly dioicous; seta long-exserted; calyptra cucullate; capsule inclined to horizontal and unsymmetric to erect and symmetric, more or less sulcate when dry; annulus of 2–4 rows of cells; operculum conic to rostrate; peristome from a short basal membrane, of 16 teeth, bifid nearly to the base and often brilliantly colored, nodose, papillose above.

Type species, *C. purpureus*.

Key.

1. Leaves of the sterile shoots elliptical to ovate, obtuse, concave and spoon-shaped; costa not percurrent ..... *4. heterophyllus.*
   Leaves of sterile shoots, with few exceptions, acute with margins strongly revolute to near the apex; costa percurrent to excurrent ..... 2.
2. Capsule inclined to horizontal, deeply sulcate when dry ..... *1. purpureus.*
   Capsule erect to slightly inclined ..... 3.
3. Capsule 2–3 mm. long; costa percurrent or shortly excurrent into a serrate point .... *3. stenocarpus.*
   Capsule 1–2 mm. long; costa mostly excurrent into a considerable slender awn nearly or quite entire ..... *2. conicus.*

1. CERATODON PURPUREUS (Hedw.) Brid. l. c.

Dicranum purpureum Hedw. Sp. Musc. 136. *pl. 36.* 1801.
Dicranum purpurascens Hedw. l. c. 137. *pl. 35.*
Ceratodon Columbiae Kindb. Rev. Bryol. **23**: 20. 1896.

Plants in wide close mats, green above when young, brown to reddish when old, perennial, polymorphous, stout and with short crowded leaves in xerophytic and alpine situations, long lax and flexuous in cool shaded moist situations; stems normally 1–2 cm. long, rarely 5 cm. or more, growing by innovations above and dying below; occasional plants bear slender flagellate innovations with much reduced leaves; leaves ovate-lanceolate to narrowly lanceolate, gradually narrowed to an acute or acuminate apex, erect-open when moist, twisted to crispate when dry, carinate, the lower smaller and less crowded, the upper reaching 2 mm. long; *margins reflexed to near the apex, more or less serrate above;* costa strong, percurrent to shortly excurrent; perichaetial leaves sheathing, the outer rather abruptly narrowed to a longer or shorter awn, the inner often very short-acuminate; all leaves without papillae; leaf cells short-rectangular to quadrate

or irregular above, thick-walled, more elongated near the base; cells of the lower base of perichaetial leaves much longer and less incrassate. Seta dark red (yellowish in varieties), often appearing lateral by reason of innovations, 1–2.5 mm. long; capsules oblong to oblong-ovoid, *inclined to horizontal when mature, more or less curved and unsymmetric, slightly strumose, regularly sulcate when dry, 2–2.5 mm. long, dark red-brown;* operculum sharply conic, curved downward; *peristome teeth 16, dark red and trabeculate below, the two filiform divisions of the teeth irregularly joined at the nodes,* the upper portion separate, with few and inconspicuous nodes, finely papillose, often bordered by a paler inner lamella; spores smooth, 10–15 μ in diameter, mature spring to summer.

Type locality, European.

Illustrations:—Hedw. l. c.; Bry. Eur. *pl. 189, 190;* M. H. M. *figs. 36, 37;* Mosses w. H.-lens (Ed. 3) *f. 25.*

Exsiccati:—Drumm. Musc. Am. 116; Sull. Musc. Allegh. 153; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 107, (Ed. 2) 159, 160; Aust. Musc. Appal. 116, 117 ? ; Holz. Musc. Acro. Bor. Am. 83, 84, 606, 83 (as *C. conicus*); R. & C. Musc. Am. Sept. 19; Allen, Mosses Cascade Mts. 15; Baker, Pacific Coast Bryophytes 595; Grout, Musci Perf. 51.

Cosmopolitan and found in all sorts of habitats and ecological conditions (e.g. on the inside of an unused chimney flue 50 ft. above the ground); fruiting freely. Frequently found on soil recently burned over. Mrs. Britton in the North American Flora **15**[1]: states that over 50 synonyms and many forms have been recorded.

1a. F. brevifolius (Milde) E. G. Britton, l. c.

Plants small, stems short, often julaceous or filiform; leaves erect-appressed, ovate, acute. Arctic; Yukon Terr.; McKinley Park, Alaska.

1b. F. aristatus (Aust.) E. G. Britton, l. c.

Plants taller, often paler; seta yellow; leaves acute or acuminate; costa excurrent; xerophytic. (Maine to New Jersey.)

1c. F. xanthopus (Sull.) E. G. Britton, l. c.

As in the last except costa percurrent; operculum sometimes beaked. (Widely distributed, especially in the South and West.) Holz. Musc. Acro. Bor. Am. 154; Baker, Pacific Coast Bryophytes 395; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 107b; Grout, Musci Perf. 280.

2. Ceratodon conicus (Hampe) Lindb. Musc. Scand. 27. 1879.

Trichostomum conicum Hampe in C. Muell. Syn. **1**: 575. 1849.
Ceratodon minor Aust. Bot. Gaz. **2**: 89. 1877.
Ceratodon purpureus Gräfii Schlieph. in Limpr. Laubm. **1**: 487. 1887.

Plants smaller, less than 1 cm. high; leaves not crisped when dry, much crowded above, ovate-lanceolate, mostly entire; costa excurrent into a linear-subulate smooth awn, rarely toothed, sometimes as long as the rest of the leaf; inner perichaetial leaves obtuse with costa often not reaching the apex; capsule erect or inclined, slightly unsymmetric and strumose.

Type locality, northern Germany.

Illustrations:—Braithw. Brit. Moss Fl. **1**: *pl. 26E;* Limpr. l. c. *f. 153;* Dixon & Jam. Handb. Brit. Mosses (Ed. 3) *pl. 9H; Pl. 18E.*

On soil, bases of stumps, etc. Rare; Minnesota, Idaho, Washington, British Columbia, and Alaska; also in Europe.

Dixon, l. c. regards this as a subspecies as he says he finds all kinds of intergradations. The typical forms like Macoun's specimens from Spence's Bridge, B. C., May 31, 1889 are so distinct as to leave no doubt as to their correct identification.

3. Ceratodon stenocarpus Bry. Eur. fasc. 29–30. *pl. 191.* 1846.

Ceratodon corsicus Bry. Eur. fasc. 43. 1850.
Ceratodon vulcanicus C. Muell. Bull. Herb. Boiss. **5**: 191. 1897.

Leaves scarcely to be distinguished from those of *C. purpureus,* varying from narrowly lanceolate and entire, to shorter and strongly dentate above, perhaps rather more crispate when dry; perichaetial leaves

longer sheathing, 3–4 mm. long. *Seta pale yellow to orange; capsule erect to inclined, narrowly cylindric, slightly unsymmetric to slightly arcuate, 2–3 mm. long,* plicate when dry and empty, brown, darker with age; *peristome teeth very slender, pale, nearly uniform in color, divisions nearly or quite separate to base, spinose-papillose,* less trabeculate than in *C. purpureus;* spores mature in autumn.

Type locality, Neilgherry Hills, India.

Illustrations:—Bry. Eur. l. c.; *Pl. 16E.*

Discovered on shaded ledges in the upper Sabino Canyon, Mt. Lemon, Santa Catalina Mts., Pima Co. Arizona, alt. 9000 ft. (Bartram, Mosses of S. Arizona 169). Known also from Mexico south to the Andes in Bolivia; also in southern Europe and tropical Asia and Africa.

Bartram's plants undoubtedly belong to this species, though perhaps worthy of varietal rank only; the leaves are shorter, more recurved when moist and more sharply toothed at apex than the other plants I have examined. The leaves vary in much the same way and to the same extent as in *C. purpureus.* The leaves of the type of *C. vulcanicus* approach those of Bartram's plants but are less strongly toothed above.

Mrs. Britton's synonymy has been adopted without change or verification (N. Am. Flora **15**[1]: 61).

4. Ceratodon heterophyllus Kindb. Ottawa Nat. **5**: 179. 1892.

Plants in thin dense sods, about 1 cm. high, light yellow-green above, dark reddish-brown below; stems branching freely by slender innovations, julaceous by the appressed leaves when dry, only the upper leaves slightly contorted; *leaves of the sterile shoots concave, spoon-shaped, obtuse and entire or nearly so,* those of the larger shoots reaching 0.5 mm. long; upper cells subquadrate, thick-walled, 10–25 μ in diameter, elongated and thinner-walled at base; costa stout, usually ending below the apex, colored in the older leaves; basal leaves of fertile plants much like the above, the median oblong-lanceolate and obtuse, with the entire margins more or less revolute, occasionally a lanceolate acute leaf; perichaetial leaves sheathing, the outer abruptly subulate, the inner obtuse; basal cells of upper and perichaetial leaves more elongated and less incrassate to midway of the leaf or more. Seta orange, 1 cm. or more in length; capsules red to orange, *mostly slightly inclined,* occasionally horizontal, *plainly strumose,* about 1 mm. long; otherwise as in *C. purpureus.*

Type locality, on soil, St. Paul Island, Behring Sea (J. M. Macoun, Aug. 8, 1891). Described from a specimen of this collection. Also reported from Agattu Id. *Pl. 16D.*

This is so distinct that it is difficult to see the reason for reducing it to a mere form of *C. purpureus.*

6. SAELANIA Lindb. Utkast 35. 1878.

Differs from *Ditrichum* in the more frequent subapical innovations; leaves glaucous with a white filamentous or granular dorsal surface, lamina plainly extending nearly or quite to the apex, mainly plane, distantly and coarsely serrate.

Many authors have included this in *Ditrichum,* but recent works treat it as more closely allied to *Ceratodon.*

Saelania glaucescens (Hedw.) Broth. Engler & Prantl (Ed. 1) Musci 300. 1901.

Trichostomum glaucescens Hedw. Stirp. Crypt. **3**: 91. 1792; Sp. Musc. 112. 1801.
Leptotrichum glaucescens Hampe, Schimp. Syn. 146. 1860.
Ditrichum glaucescens Hampe, Flora **50**: 182. 1867.
Saelania caesia Lindb. Utkast 35. 1878.

Plants *densely cespitose, glaucous-green;* stems erect, slender, 1–2 cm. high, freely branching; lower leaves small, lanceolate below, acute to acuminate, larger above, upper and perichaetial 1.5–2 mm. long, more crowded, gradually linear-subulate, from a broader base, not sheathing, erect-open, somewhat contorted when dry; margins plane or slightly recurved below, bluntly serrate above; costa stout, sometimes slightly rough on the back at apex, percurrent, to slightly excurrent in the upper leaves; upper blade cells short-rectangular, rather thick-walled and slightly rounded at the corners, 1–2 : 1, more elongated at base, sometimes bi-stratose along the margins. Autoicous; antheridia terminal on short branches below the perichaetia; seta 5–10 mm. long; calyptra cucullate; capsule erect and symmetric, slightly wrinkled when dry; urn 1.5–2.25 mm. long, oblong-cylindric, broadest near base; operculum conic-rostrate, reaching 0.7 mm. in length; annulus large, of 2–3 rows of cells; peristome deep red, from a short basal membrane, teeth bifid into capil-

lary divisions, spinose-papillose and more or less united at the nodes; spores faintly papillose, about 15 μ in diameter, mature in summer.

Type locality, Sweden.

ILLUSTRATIONS:—Bry. Eur. *pl. 184;* Braithw. Brit. Moss Fl. **1**: *pl. 26F; Pl. 18F.*

EXSICCATI:—Drumm. Musc. Am. 177; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 156; Aust. Musc. Appal. 121; Macoun, Can. Musci 68; Holz. Musc. Acro. Bor. Am. 13.

On thin soil in rock crevices in alpine and subarctic regions; Greenland to Alaska, south to New England, New Jersey, Minnesota and the Rocky Mts.; not common.

Distinguished by the glaucous-green color which Braithwaite says is due to a mealy production on the leaves.

7. DITRICHUM [Timm] Hampe, Flora, **50**: 181. 1867 (nomen conservandum).

Leptotrichum Hampe, Linnaea **20**: 74. 1847.

Plants small, loosely or closely gregarious; stems with few exceptions less than 1 cm. high, leaves not distichous, lanceolate-subulate, often with a linear-filiform awn, entire or serrate, basal cells rectangular to oblong, without inflated angular cells (except forms of *flexicaule*), upper cells linear, rectangular, or oval; costa broad and strong, usually percurrent or excurrent; perichaetial leaves usually larger and more or less sheathing at base. Dioicous or monoicous; seta slender, long exserted; calyptra cucullate; capsules ovoid to cylindric, mostly erect and symmetric but sometimes arcuate or inclined, smooth to somewhat wrinkled when dry; operculum conic to short-rostrate; annulus present, usually large; peristome usually from a short basal membrane, the 16 teeth usually more or less completely split into two filiform divisions, in most cases plainly papillose, sometimes slightly twisted.

Type species, *D. pusillum*. Both the peristome and the leaf structure show a close affinity to *Trichostomum* and related genera of the Pottiaceae.

KEY.

1. Plants (except occasional sterile forms) not over 1.5 cm. high, usually less	2.
Plants normally 5–10 cm. or more in height	11.
2. Awn more or less rough throughout	3.
Awn smooth or rough only at extreme apex	4.
3. Seta 10–15 mm. long; capsule narrowly cylindric	*11. cylindricum.*
Seta 5–7 mm. long; capsule ovoid-cylindric	*12. boreale.*
4. Seta bright yellow; capsules wrinkled when dry; spores rough	5.
Seta red to brown (pale yellow in *montanum*), capsules not often wrinkled; spores smooth	6.
5. Awn serrulate; spores 14–18 μ in diameter; eastern	*9. pallidum.*
Awn nearly entire; spores 21–27 μ; western	*10. Schimperi.*
6. Leaf margins more or less recurved and serrulate above; dioicous	7.
Leaf margins plane or incurved	10.
7. Operculum long conic-rostrate, ⅓–½ the length of the urn; peristome teeth 0.5–1 mm. long, spinose-papillose, almost without nodes except at very base	8.
Operculum short-conic; peristome teeth 0.2–0.35 mm. long; peristome teeth faintly papillose, nodose at base	9.
8. Perichaetial leaves entire to slightly serrate	*3. ambiguum.*
Perichaetial leaves strongly serrate	*4. tortuloides.*
9. Perichaetial leaves with awn equal in length to broad base or much longer	*1. pusillum.*
Awn of perichaetial leaves much shorter than the sheathing base	*2. lineare.*
10. Leaf margins unistratose, cells of upper blade much longer than broad	*6. heteromallum.*
Leaf margins bistratose, upper cells little longer than broad	*5. montanum.*
11. Leaves 1–3 mm. long; perichaetial leaves gradually subulate	*7. flexicaule.*
Leaves 5–7 mm. long; perichaetial very abruptly subulate	*8. giganteum.*

1. DITRICHUM PUSILLUM (Hedw.); E. G. Britton, N. Am. Fl. **15**[1]: 62. 1913.

Didymodon pusillus Hedw. Sp. Musc. 104. 1801.

Trichostomum tenue Hedw. l. c. 107.

Leptotrichum pusillum Hampe, Linnaea **20:** 74. 1847.
Leptotrichum tortile C. Müll. Syn. **1:** 454. 1848.
Ditrichum tortile Brockm. Laubm. Meckl. 74. 1869.
Leptobarbula berica Macoun, Cat. Can. Pl. **6:** 49, 1892. Not of Schimper 1876.

Plants in thin dense sods, light to yellowish-green, often very dark with age, variable in the size of all parts; stems mostly simple, erect from a radiculose base, sometimes inclined toward the light, 5–10 mm. or more long; lower leaves lanceolate, about 1 mm. long, the upper 2–3 mm. long, lanceolate-subulate, erect to somewhat spreading, *little contorted when dry*, canaliculate above; *margins somewhat revolute*, more or less serrulate, especially above; costa broad, percurrent to excurrent into a subulate apex, which is channelled and denticulate; lower leaf cells narrowly rectangular to hexagonal, pellucid, sometimes colored at base, thin-walled, smooth, 10–15 μ wide, 2–5 : 1 in the perichaetial leaves; shorter and smaller in the lower leaves; upper blade cells smaller and thicker-walled, about 2 : 1, the apical sometimes bistratose; perichaetial leaves with a longer oblong base, more or less sheathing. Dioicous; antheridia terminal; seta red-brown, 5–15 mm. long; calyptra cucullate; capsule oblong-cylindric to ovoid, 0.5–1.5 mm. long, reddish to brown, not sulcate or constricted below the mouth when dry; exothecial cells irregularly short-rectangular to polygonal; annulus of large cells; peristome short, of 16 reddish teeth split into linear-subulate divisions nearly to the base, united into a short basal membrane, papillose, trabeculate below, often slightly twisted; operculum conic-rostellate; spores smooth, 10–15 μ in diameter, mature in autumn.

Type locality, Leipzig, Germany.

Illustrations:—Hedw. l. c. *pl. 24;* Jennings, Mosses W. Pennsylvania *pl. 6; Pl. 28.*
Exsiccati:—Drumm. Musc. Am. 118, S. States 57–59; Sull. Musc. Allegh. 175; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 103, (Ed. 2) 152, 153; Aust. Musc. Appal. 118; Macoun, Can. Musci 65, 486, Grout, Musci Perf. 109.

On moist bare soil, banks, ditches and fields; Labrador to Katmai Id., Alaska; south to British Columbia, California (doubtfully), Louisiana and Florida; common in the northern U. S. on soil denuded and not yet occupied with other vegetation. Often found with *Pogonatum pennsylvanicum.*

Exceedingly variable in all parts, often due to environmental conditions, and grading into the next.

2. Ditrichum lineare (Sw.) Lindb. Acta Soc. Sci. Fenn. **10:** 108. 1871.

Didymodon lineare Sw. Adnot. Bot. 100. 1829.
Trichostomum vaginans Sull. Musc. Allegh. 176. 1845.
Leptotrichum vaginans Schimp. Syn. (Ed. 2) 140. 1876.
Trichostomum nodulosum Aust. Bull. Torr. Club **6:** 73. 1876.

Differs from the preceding in the following particulars; *stems branching freely by slender innovations;* leaves blunt, margins less serrulate and less revolute, awn shorter; perichaetial leaves long-sheathing, short-awned; capsule longer, urn reaching 1.75 mm. long, usually about 1.5 mm., nearly cylindric and often slightly wrinkled when dry; operculum 0.5 mm. high; annulus larger, often of one row of very large cells with two rows of smaller cells at base; peristome more irregularly divided.

Type locality, Lancaster, Pa.

Illustrations:—Sull. Icones Musc. *pl. 28; Pl. 28.*
Exsiccati:—Drumm. Musc. Am. 60, 61; Sull. Musc. Allegh. 176; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 104, (Ed. 2) 154; Aust. Musc. Appal. 119; Macoun, Can. Musci 386; Holz. Musc. Acro. Bor. Am. 311 (as *D. heteromallum*).

Habitat similar to the last; Prince Edward Id. to S. Carolina and Missouri; also in Europe.

Although most recent authors consider it distinct from the last, there are many intermediate forms, and plants from the same tuft vary in the distinguishing characters. Mrs. Britton to the contrary notwithstanding, the perichaetial leaves of *D. pusillum* are always more or less sheathing. Immature peristomes of both species are less papillose than those fully mature.

Austin's Musci Appal. Suppl. 490 from the White Mts. of New Hampshire as *D. homomallum* is certainly not that species as the leaf margins are revolute and bistratose. It seems close to *D. vaginans subvaginans* Roth. The leaves are longer and more serrulate than in *lineare* and the awn from once to twice the length of the sheathing base. It is approached by Holzinger's Musc. Acro. Bor. Am. 311. The peristomes of both these forms seem like those of typical *D. lineare.*

3. Ditrichum ambiguum Best, Bull. Torr. Club **20:** 117. 1893.

Plants gregarious, about 1 cm. high, light to dark green; leaves erect-spreading from imbricate bases, somewhat crisped when dry, the lower lanceolate, 1 mm. or less in length, the upper long-lanceolate-subulate,

2 mm. or more in length, clasping at base, canaliculate above, upper margins entire or serrulate, more or less recurved, undulate and bistratose; perichaetial leaves larger and long-sheathing, not abruptly narrowed, *nearly entire except at the extreme apex;* leaves of sterile stems more strongly serrate, often narrowly obtuse; costa percurrent, more or less papillose on the back near apex; basal leaf cells of lower leaves short-rectangular, about 2 : 1, thick-walled; cells of the sheathing base of perichaetial leaves oblong-hexagonal, thin-walled, 10–15 μ wide, 5–7 : 1. Dioicous; seta about 1 cm. long, red; capsule oblong- to narrowly cylindric, often slightly unsymmetric, *1–2 mm. long*, 0.4–0.5 mm. thick; *operculum long, conic-rostrate, 0.6–0.8 mm. long;* annulus large, of 2–3 rows of cells; exothecial cells oblong-rectangular, moderately incrassate, 15–18 μ wide, 3–5 : 1; peristome teeth red, 0.4–0.55 mm. long, divided to the narrow basal membrane into *two capillary segments, not nodose or trabeculate, rarely connate, strongly spinose-papillose as in D. pallidum, papillae more than 1 μ high;* spores smooth, 9–11 μ, mature in late autumn to winter.

Type locality, Mason Co., Washington. *Pl. 29.*

Exsiccati:—Holz. Musc. Acro. Bor. Am. 137, 613 (as *D. pusillum*).
On banks of bare soil; California, Washington, Oregon, and British Columbia.
Occasionally the peristome teeth will show signs of nodes near the base.

4. Ditrichum tortuloides Grout, Bryol. **30**: 4. 1927.

Too near the last, differing chiefly in the smaller size, strongly serrate and undulate perichaetial leaves and rather shorter, thicker-walled and more colored basal cells of the same; spores in spring.

Type locality, Newfane, Vt. *Pl. 29.*

Exsiccati:—Grout, Musci Perf. 89 (from the type locality).
On soil in old roads and on banks; also from Jackson, N. H., Staten Island, N. Y., and in central Europe.

5. Ditrichum montanum Leiberg, Bull. Torr. Club **20**: 112. 1893.

Plants loosely cespitose; stems 5–10 mm. long, rarely twice that, sparingly branched; leaves erect-open when moist, somewhat contorted but scarcely crisped when dry, lanceolate-subulate, not papillose, the upper and perichaetial reaching 2 mm. or more in length, *canaliculate with incurved subserrulate margins*, which are narrowly bistratose; costa broad, ending in or below the serrulate apex; lamina narrow above, consisting of irregular to subquadrate incrassate cells about 10 μ wide; in the median lamina the cells are short-rectangular becoming gradually longer to the colored basal cells; in the perichaetial leaves the cells of the sheathing base are much longer, reaching 30 x 140 μ, and thin-walled. Autoicous; antheridia terminal on basal branches; *seta yellow*, 1.5–2.5 cm. long; capsule 2–3 mm. long, erect and symmetric, ovoid-cylindric, narrowest at the mouth, sometimes shriveled but not plicate when dry; calyptra ⅓ length of capsule; operculum conic-rostrate; annulus double; peristome teeth bifid nearly to the short basal membrane, nodose at base, the divisions filiform and spinose-papillose; *exothecial cells narrowly linear-oblong and pale* except for a few rows of short irregular reddish cells around the mouth; spores smooth, about 10 μ in diameter, apparently mature in spring.

Type locality, Idaho.

Illustrations:—Bull. Torr. Club l. c. *pl. 143; Pl. 31.*
On bare soil and roots of trees; Idaho and Washington; apparently rare and of limited distribution.
Closely allied to *D. ambiguum* but distinct in the incurved margins of the leaves, the shorter leaf cells, the yellow seta and the elongated exothecial cells.

6. Ditrichum heteromallum (Hedw.) E. G. Britton, N. Am. Flora **15**[1]: 64. 1913.

Weisia heteromalla Hedw. Stirp. Crypt. **1**: 22. *pl. 8.* 1787; Sp. Musc. 71. 1801.
Didymodon homomallum Hedw. Sp. Musc. 105. 1801.
Trichostomum homomallum Bry. Eur. *pl. 181.* 1843.
Ditrichum homomallum Hampe, Flora **50**: 182. 1867.

Plants loosely tufted, pale to yellowish-green; stems mostly simple, 5–10 mm. high, rarely branching and reaching 4 cm.; leaves spreading, twisted or subsecund above when dry, *gradually narrowed* to a *long filiform concave awn* from an ovate or broadly lanceolate base *much shorter than the awn*, 2, rarely 3, mm. long; *margins plane, entire except occasionally toothed at apex* and rarely below in some leaves; costa broad, excurrent into the slender awn; lower leaf cells narrowly rectangular to linear near the margin, shorter above,

all slightly incrassate; perichaetial leaves sheathing at base, longer and rather more abruptly narrowed. Dioicous; seta red, 1–2 cm. long; capsule dark red, oblong to oblong-ovoid, erect and symmetric or nearly so, urn 2 mm. or more long; operculum long-conic; annulus large, of 2–3 rows of cells; peristome red, from a narrow basal membrane, teeth divided into filiform, lightly papillose segments, more or less united at the joints below, reaching 0.3 mm. in length; spores smooth, 12–14 μ in diameter; maturing autumn to winter.

Type locality, Saxony, Germany.

ILLUSTRATIONS:—Hedw. l. c. *pl. 23;* Bry. Eur. *pl. 181; Pl. 30.*

EXSICCATI:—Drumm. Musc. Am. 119; Macoun, Can. Musci 451; Holz. Musc. Acro. Bor. Am. 511.

Mountain regions from the west side of the Rockies to California, Washington and Alaska; Nova Scotia (Prince); also in Europe; rare.

7. DITRICHUM FLEXICAULE (Schwaegr.) Hampe, Flora **50:** 182. 1867.

Cynodontium flexicaule Schwaegr. Suppl. **1**[1]**:** 113. *pl. 29.* 1811.
Trichostomum flexicaule Bry. Eur. fasc. 18–20. *pl. 180.* 1843.
Leptotrichum flexicaule Hampe, Linnaea **20:** 74. 1847.

Plants typically *in dense tomentose sods 2–10 cm. thick, silky* and yellowish-green above, *brown and matted with tomentum below,* sometimes shorter or less dense; stems erect and crowded or loosely tufted and flexuose, fragile and branched; leaves not crowded but overlapping, erect to spreading, somewhat contorted when dry, often somewhat secund, 1–4 mm. long, from a long-lanceolate base gradually narrowed to a much longer filiform concave awn, entire or slightly toothed at apex; costa broad, excurrent; basal leaf cells oblong-rectangular, about 15 μ wide, 2–3 : 1, the alar inflated-quadrate; median cells of leaf base oblong-linear, incrassate, sometimes with walls more or less pitted; marginal basal cells shorter except that the marginal row is sometimes linear; cells along the costa above the broad base rounded, short, linear to nearly quadrate, smaller; perichaetial leaves from a much larger oblong-sheathing base more abruptly narrowed to the long awn. Dioicous; male plants slender; bracts ovate, subulate, the inner ecostate; seta reddish, 1–2.5 cm. long; capsule erect, reddish-brown, oblong-cylindric to ovoid, enlarged at base, narrowest at mouth; urn 1–2 mm. long; exothecial cells irregularly oblong-hexagonal; operculum conic-cylindric, appearing rostellate when dry, up to 0.6 mm. long; peristome red, 0.4–0.5 mm. long, teeth bifid nearly to the short basal membrane, sometimes with the divisions irregularly united at base, filiform and spinose-papillose, not trabeculate or nodos eexcept near the base, more or less unequal; annulus large; spores 7–10 μ, smooth, maturing in spring.

Type locality, Switzerland.

ILLUSTRATIONS:—Bry. Eur. l. c.; Braithw. Brit. Moss Fl. *pl. 15A;* Dixon, Handb. Brit. Mosses (Ed 3) *pl. 8H; Pl. 29, 30.*

EXSICCATI:—Macoun, Can. Musci 461, 490; Holz. Musc. Acro. Bor. Am. 562.

On moist shaded banks and ledges, preferably limestone, in alpine and subarctic regions; Greenland and Nova Scotia to Ontario, Minnesota, British Columbia and Alaska.

This species is exceedingly variable especially in the sterile forms which principally represent it in N. America. The following are frequent.

7a. Var. DENSUM (Bry. Eur. l. c.) Braithw. Brit. Moss Fl. **1:** 101. 1881.

Leptotrichum flexicaule var. *densum* Bry. Eur. l. c.
Distichium Macounii C. M. & Kindb.; Macoun, Cat. Can. Pl. **6:** 40. 1892.

Densely tufted, shorter, 2–5 cm. high; leaves nearly erect, much shorter, straight, almost entire; elongated cells in base almost or quite lacking; leaf cells incrassate, rounded, isodiametric to somewhat longer than broad, lumen 7–12 μ wide. This merges into its form *brevifolium. Pl. 29.*

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 535 (as var. *brevifolium*); Drumm. Musc. Am. 126.

7b. f. BREVIFOLIUM (Kindb.) **n. comb.**

Leptotrichum flexicaule subsp. *brevifolium* Kindb.; Macoun, Cat. Can. Pl. **6:** 46. 1892.
Ditrichum elatum Kindb. Eur. & N. Am. Bryin. 181. 1897.

Leaves very short and straight, sometimes only 1 mm. long, broadly lanceolate to lance-subulate from an ovate base. *Pl. 29.*

Exsiccati:—Holz. Musc. Acro. Bor. Am. 359 & 12. This last is not the extreme form. Ontario, Minnesota and elsewhere with the species.

These forms are found frequently east of the Rockies in the Mississippi valley and in southern Canada, especially in arctic-alpine regions. They are so different that one not familiar with the variations of this species would never suspect their relationship. Intermediate graduated forms make this certain however. Probably these varieties are reduced forms due to unfavorable conditions.

8. Ditrichum giganteum Williams, Bull. N. Y. Bot. Gard. **2**: 113. 1901.

Didymodon flexicaule sterile DeNot. Syll. Musc. 197. 1838.
Ditrichum flexicaule longifolium I. Hagen, Tromso Mus. Aarsh. **21–22**: 40. 1899.

Plants in lax yellow-green cushions up to 12 cm. high; differing from the last in the longer (5–7 mm.) leaves, subtubulose at base, more noticeably serrate at apex; *perichaetial leaves very abruptly rounded to a filiform awn from a broadly ovate sheathing base;* peristome without a basal membrane, teeth mostly entire and not bifid; spores in autumn.

Type locality, Columbia Falls, Montana (Williams).

Illustrations:—Bull. N. Y. Bot. Gard. l. c. *pl. 15; Pl. 31.*
Exsiccati:—Holz. Musc. Acro. Bor. Am. 404; Drumm. Musc. Am. 125.
On gravel banks and sand bars and in crevices of rocks; Rocky Mts. from Montana to the Yukon; around the Great Lakes in Minnesota and ~~Michigan~~. Also in Europe.

9. Ditrichum pallidum (Schreb., Hedw.) Hampe, Flora **50**: 182. 1867.

Trichostomum pallidum Hedw. Sp. Musc. 108. 1801.
Leptotrichum pallidum Hampe, Linnaea **20**: 74. 1847.
Ditrichum rhynchostegium Kindb. Rev. Bryol. **37**: 14. 1910.

Plants loosely gregarious, bright yellow-green; stems about 5 mm. long, more or less erect from a creeping base, mostly simple, central strand large; leaves erect-spreading, sometimes secund, somewhat contorted when dry, long linear-subulate from a lanceolate base (often ovate in the upper and perichaetial), concave, channelled above; margins often distantly serrate in upper basal part and of more than one layer of cells along the costa; costa strong, long-excurrent, toothed towards the apex; basal cells laxly oblong-hexagonal, up to 65 x 25 μ or more, narrower toward the margin, thin-walled; along the shoulders of abruptly narrowed perichaetial leaves are a variable number of much smaller irregular cells; perichaetial leaves subclasping. Paroicous; antheridia in axillary buds below the perichaetium; seta 1–4 cm. long, slender, *yellow to orange;* capsules *mostly inclined and somewhat unsymmetric, faintly strumose, oblong-ovoid, light brown to yellowish;* urn 1–2.5 mm. long, *irregularly sulcate when dry and empty, narrower at the mouth;* operculum conic-obtuse, reaching 1 mm. in length; annulus of 1–3 rows of cells; calyptra cucullate, smooth, rostrate, reaching 2.5 mm.; peristome teeth 16, 0.5 mm. or more long, from a short basal membrane, divided more or less completely into two filiform segments, closely *spinose-papillose,* reddish; spores coarsely warty, 14–18 μ in diameter, mature in early spring in the North, in Feb. to April in Florida.

Type locality, near Leipzig, Germany.

Illustrations:—Bry. Eur. *pl. 183;* M. H. M. *f. 33;* Jennings, Mosses W. Pa., *pl. 6; Pl. 28.*
Exsiccati:—Drumm. Musc. Am. S. States 56; Sull. Musc. Allegh. 174; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 105, (Ed. 2) 155; Aust. Musc. Appal. 120; R. & C. Musc. Am. Sept. 22; Macoun, Can. Musci 67; Holz. Musc. Acro. Bor. Am. 14; Grout, Musci Perf. 47.
Dry sandy fields; Nova Scotia to Ontario, south to Florida, Texas and Oklahoma.
The majority of American plants have a less abruptly narrowed base in the perichaetial leaves than the European. Specimens from Nova Scotia (Miss Margaret Brown) have a longer oblong, clasping base with a larger number of small irregular cells at the leaf shoulders than is normal in European plants, and a peristome rather more than 1 mm. long.

10. Ditrichum Schimperi (Lesq.) Paris, Index Bryol. 391. 1895.

Leptotrichum Schimperi Lesq. Mem. Calif. Acad. **1**: 9. 1868.

Plants gregarious, yellowish; stems erect, mostly simple, 3–5 mm. long; leaves close, erect-spreading, somewhat secund and flexuose when dry, long filiform-subulate from a short ovate to lanceolate base, 3–5 mm. long, entire except at apex; costa broad, nearly filling the awn, percurrent to excurrent; basal leaf cells

oblong, thin-walled, about 15 μ wide, 4–7 : 1, marginal narrower; cells of upper base shorter, many short-rectangular, those along the costa linear; perichaetial leaves sheathing at base. *Autoicous; antheridia in small buds below the perichaetium;* seta yellowish, 1–2 cm. long; capsules erect to inclined, 1.5–2.5 mm. long, ovoid-cylindric, somewhat furrowed when dry; operculum short-rostrate; *calyptra large, cucullate and twisted; annulus narrow;* peristome *about 0.3 mm. long,* from a narrow basal membrane; teeth red, divided into 2 filiform segments above, irregularly perforate or divided below, *papillose, nodose only at base; spores large, 21–27 μ, rough,* mature in June.

Type locality, Coast Ranges near Mendocino City, California.

Illustrations:—Sull. Icones Musc. Suppl. *pl. 24; Pl. 32.*
Exsiccati:—Holz. Musc. Acro. Bor. Am. 310.
On clay soil and banks; California to Vancouver Id.
The peristome is shorter and less strongly papillose than in *D. pallidum* and the seta less conspicuously yellow.

11. Ditrichum cylindricum (Hedw.) **n. comb.**

Trichostomum cylindricum Hedw. Sp. Musc. 107. *pl. 24. f. 7-13.* 1801. Not of C. Muell. 1849.
Trichodon tenuifolius Schrad. Lindb. Oefv. Sv. Vet.-Akad. Förh. **21:** 225. 1864.
Ceratodon cylindricus Bry. Eur. fasc. 29–30. *pl. 192.* 1846.
Didymodon cylindricus Wahlenb. Fl. Suec. **2:** 754. 1826. Not of Bry. Eur.

Plants in loose thin yellowish-green tufts; stems short, rarely over 5 mm. long, slender, mostly simple; radicles sometimes producing small brown tubercles; leaves 1–2 mm. long, the base oblong to ovate, sheathing, abruptly contracted to a linear-subulate awn much longer than the base, recurved, *flexuose and very rough;* costa strong, filling the whole upper part of the awn; basal cells smooth, oblong, 7–15 μ wide, 4–7 : 1, sometimes colored; upper cells of blade shorter and irregular; upper leaf margin plane and more or less irregular in outline; perichaetial leaves longer, and longer-sheathing. Dioicous; male plants in separate tufts; seta slender, 10–15 mm. long, yellow to red; calyptra cucullate; *capsule narrowly cylindric, not plicate when dry,* usually somewhat curved, erect or inclined; urn reaching 2 mm. long; median exothecial cells about 1 μ wide, 5–8 : 1, incrassate; operculum bluntly conic, 0.4 mm. high; annulus large, revoluble; peristome red to yellowish, teeth *very minutely papillose,* slender, split nearly to the base into capillary divisions which are more or less united at the nodes below; spores smooth, 12–14 μ in diameter, mature in summer.

Type locality, Germany.

Illustrations:—Bry. Eur. l. c.; Hedw. l. c.; *Pl. 33.*
Exsiccati:—Macoun, Can. Musci 411; R. & C. Musc. Am. Sept. 278; Grout, Musci Perf. 114; Holz. Musc. Acro. Bor. Am. 549.
Wet sandy soil in fields, ditches and banks; western North America, Yukon to Montana, Nevada and Washington. Apparently infrequent.
I agree with Braithwaite and Dixon that this is better placed in *Ditrichum* than in a separate genus. The fact that *Trichostomum cylindricum* (Bruch) C. Müll., an entirely different species belonging in the *Pottiaceae,* has also been called *Didymodon cylindricus* has caused considerable confusion.

12. Ditrichum boreale (Williams) **n. comb.**

Trichodon borealis Williams, Bryol. **14:** 5. 1911.

Plants loosely gregarious, growing with other species; stems simple or branching from subapical innovations, 2–5 mm. high; leaves distant below, larger above, reaching 2 mm. or more in length, from an ovate clasping base rather gradually narrowed to a spreading-flexuous, subulate, channelled apex, which is more or less papillose-roughened on the back and serrulate along the margins; costa strong, but not filling all of the awn except in some cases at and near the apex; leaf cells smooth, irregularly rectangular, about 6 x 8–12 μ, the lower and basal much longer, oblong-hexagonal to oblong-rectangular; inner perichaetial leaves with a broader sheathing base more abruptly narrowed to a rough spreading awn. Dioicous; seta brownish, straight or flexuose, 5–7 mm. long; capsule erect or inclined, slightly unsymmetric; urn up to 1 mm. long; operculum conic, blunt or apiculate; annulus large, of 3 rows of cells; peristome teeth not quite smooth, divided into two narrow prongs nearly to the base, 8–9 jointed; spores smooth, about 12 μ in diameter, mature in summer.

Type locality, near Dawson, Yukon Terr., July 9, 1899.

ILLUSTRATIONS:—Bryol. l. c. *pl. 2; Pl. 33.*

Type seen; collected among various other species on damp earth in a small ravine just back of Dawson. Differs from the preceding by the seta and capsule only about ½ as long, the shorter operculum, the shorter less papillose peristome and the less roughened awn of the perichaetial leaves.

Family SELIGERIACEAE.

Plants very small (except *Blindia*), gregarious, growing exclusively on a rocky substratum of sandstone or limestone; stems simple or branching; leaves mostly subulate from a broader base, entire or serrulate, awn in most cases consisting chiefly of the percurrent or excurrent costa; leaf cells smooth, the basal more elongated, the alar differentiated in *Blindia* only; perichaetial leaves usually larger and with a longer awn; seta well exserted, straight or curved; *capsules small, short-ovoid to pyriform, often with a broad mouth and turbinate when dry;* operculum rostrate; peristome usually present, single, *of 16 undivided teeth without a median line, entire, partially split or perforate.*

KEY TO THE GENERA.

1. Plants very small, less than 1 cm. high; alar cells not enlarged ..... 2.
   Plants much larger; alar cells enlarged ..... 3. *Blindia.*
2. Capsule not striate; peristome teeth, if present, smooth; annulus lacking ..... 1. *Seligeria.*
   Capsule striate; teeth truncate, papillose; annulus present ..... 2. *Brachydontium.*

1. SELIGERIA Bry. Eur. fasc. 33–36. 1846.

Plants very small, mostly 5 mm. high or less; stems simple or with short basal branches, occasionally with longer innovations, central strand present; the upper leaves longer, crowded, mostly subulate from a broader often clasping base; costa of uniform cells, often thick and excurrent; lower leaf cells larger and thinner-walled than the upper; perichaetial leaves not much different, often larger with a longer awn; seta well exserted, erect or curved; calyptra cucullate; capsule ovoid to pyriform, very small, mostly with a short neck; operculum rostrate; annulus lacking; peristome sometimes lacking, when present of 16 teeth, mostly entire and smooth, sometimes thick at the nodes, erect or recurved when dry.

Type species, *S. pusilla.*

KEY.

1. Peristome lacking; leaves more or less serrulate ..... 1. *Doniana.*
   Peristome present; leaves serrulate or entire ..... 2.
2. Seta straight or nearly so; capsules broadest at the mouth ..... 3.
   Seta recurved when moist; capsules slightly narrowed at the mouth, or at least no wider than in the middle ..... 6.
3. Capsule urn hemispheric, without neck; columella persistent ..... 4. *tristichoides.*
   Capsule urn pyriform or turbinate, with a distinct neck; columella not persistent ..... 4.
4. Stem 1 mm. high or less; leaves not 3-ranked ..... 5.
   Stem 3–10 mm. high, or more ..... 7.
5. Leaves finely serrulate, the awn long, slender, and tapering ..... 3. *pusilla.*
   Leaves entire or nearly so, the awn short, thick, and abrupt ..... 2. *calcarea.*
6. Leaves entire; costa filling the long smooth awn ..... 6. *recurvata.*
   Leaves often serrulate; costa not filling the short papillose apex ..... 7. *campylopoda.*
7. Plants smaller (up to 5 mm.); leaves trifarious, perichaetial reaching 1.5 mm. ..... 5. *trifaria.*
   Plants larger (5 mm. or over); leaves not trifarious, perichaetial reaching 2 mm. ..... 8. *polaris.*

1. SELIGERIA DONIANA (Sm.) C. Muell. Syn. **1**: 420. 1848.

Gymnostomum Donianum Sm. Engl. Bot. *pl. 1582.* 1806.
Anodus Donianus Bry. Eur. fasc. 33–36. *pl. 109.* 1848.
Seligeria Donii Lindb. Oefv. Sv. Vet.-Akad. Förh. **21**: 187. 1864.

Plants minute, gregarious; stems erect, rarely 1 mm. long, simple or branching from the base; leaves crowded, erect, straight, reaching 1 mm. long, subulate from a broader ovate-lanceolate, serrulate base;

costa strong, percurrent or short-excurrent in the upper leaves, occupying the greater part of the minutely denticulate awn; basal cells oblong, rectangular or rhomboidal, clear, rather incrassate, the upper shorter; perichaetial leaves lanceolate, gradually narrowed, more or less sheathing. Autoicous; antheridia in basal buds; seta straight, reaching 2 mm. long; capsule minute, pyriform, hemispherical to turbinate when dry and empty, with a short stomatose neck, without the obliquely conic-rostrate operculum about 0.5 mm. long; peristome lacking; spores smooth, 8–10 μ in diameter, mature in late summer.

Type locality, England.

ILLUSTRATIONS:—Bry. Eur. l. c.; Braithw. Brit. Moss Fl. **1:** *pl. 16G; Pl. 35.*
EXSICCATI:—Drumm. Musc. Am. 22; Sull. Musc. Allegh. 142 (in part); Grout, Musci Perf. 178.
Moist hollows and crevices of ledges, rare. Ontario, Maine, New York, New Jersey, Ohio, Tennessee; Minnesota to Alberta; most frequently collected in Ontario.

2. SELIGERIA CALCAREA (Dicks., Hedw.) Bry. Eur. l. c. *pl. 110.* 1846.

Weissia calcarea Hedw. Sp. Musc. 66. *pl. 11.* 1801.

Surprisingly like *S. Doniana;* differs in the leaves entire or nearly so, with awn stouter; peristome present, incurved or recurved when dry, red brown, teeth fragile, smooth.

Type locality, England.

ILLUSTRATIONS:—Hedw. l. c.; Bry. Eur. l. c.; Braithw. Brit. Moss. Fl. **1:** *pl. 17B; Pl. 34.*
EXSICCATI:—Drumm. Musc. Am. 65; Sull. Musc. Allegh. 142 (in part).
On wet limestone rocks; near Columbus, Ohio; near Chilson Lake, New York; Ontario to Manitoba.

3. SELIGERIA PUSILLA (Hedw.) Bry. Eur. l. c. 1846.

Weisia pusilla Hedw. Stirp. Crypt. **1:** 74. *pl. 28.* 1787.
Didymodon pusillus Hedw. Sp. Musc. 104. 1801.

Plants minute, in loose dark-green tufts; stems simple or branching from the base, about 1 mm. high; lower leaves short, lanceolate-subulate; upper longer, *long filiform-subulate* from *a denticulate base,* reaching 2 mm. long; margins incurved, *subdenticulate;* basal cells much as in the two preceding. Autoicous; antheridia in lateral buds; seta erect, much longer than perichaetial leaves, 1.5–3 mm.; *capsule obovoid-pyriform,* erect and symmetric, with beaked operculum about 1 mm. long; neck conspicuous, stomatose; exothecial cells incrassate, short and irregular, little longer than broad; *peristome teeth reddish, broadly lanceolate, smooth, entire, with 6–8 distinct joints,* inserted below the mouth, reflexed when dry, incurved when moist; spores 10–14 μ, mature in summer.

Type locality, Hanover, Germany.

ILLUSTRATIONS:—Hedw. l. c.; Bry. Eur. *pl. 110;* Braithw. l. c. *pl. 16H; Pl. 34.*
EXSICCATI:—Drumm. Musc. Am. S. States 35; Holz. Musc. Acro. Bor. Am. 421.
Damp shaded cliffs and ledges, principally limestone; Quebec, Ontario; Kelley's Island, Lake Erie; Minnesota to Missouri.
Quite variable in size and length of leaves.

4. SELIGERIA TRISTICHOIDES Kindb. Rev. Bryol. **23:** 20. 1896.

Seligeria trifaria patula Lindb. Oefv. Sv. Vet.-Akad. Förh. **21:** 189. 1864.
Seligeria tristicha laxa Holz. Bryol. **5:** 9. 1902.
Seligeria tristichoides laxa Holz. l. c. 63. 1902.

Plants in bright green cushions; stems 2–5 mm. high, crowded, sending out numerous slender, short sterile innovations with short, 3-ranked leaves; leaves of fertile stems less conspicuously 3-ranked, spreading to reflexed, the lower shorter, the upper crowded, 1 mm. long (or less), lanceolate-subulate with the percurrent or excurrent costa *forming a stout rough awn;* cells of the hyaline base rectangular to oblong, upper cells much shorter and more dense; perichaetial leaves a little longer. Autoicous; antheridia few, in axillary or basal buds; seta erect or somewhat curved, scarcely twice the length of the perichaetial leaves; *capsules ovoid, the urn hemispheric when empty,* less than 1 mm. high, *without neck; columella more or less persistent* and exserted; stomata imperfect, occurring around the middle of the capsule; exothecial cells incrassate, irregular, little longer than broad, protruding when dry; peristome red, inserted below the capsule mouth, incurved when moist, smooth, occasionally perforate, with 10–12 narrow joints; spores minutely roughened, 18–22 μ in diameter, mature in early summer.

Type locality, Norway.

ILLUSTRATIONS:—Bryol. **5:** 8. *f. 2–5; Pl. 35B.*
Collected but once in N. America by Dr. Geo. G. Kennedy on the cliffs at Lake Willoughby in Northern Vermont.

5. SELIGERIA TRIFARIA (Brid.) Lindb. Oefv. Sv. Vet.-Akad. Förh. **20:** 413. 1863.

Weisia trifaria Brid. Jour. Bot. Schrad. **1801**[1]: 283. 1801.
Weisia tristicha Brid. Musc. Recent. Suppl. **1:** 116. 1806.
Seligeria tristicha Bry. Eur. fasc. 33–36. *pl. 111.* 1846.

Distinguished from *S. tristichoides* by the more slender leaves with a smoother awn; capsules with a conspicuous, stomatose neck; larger spores, 24–32 μ, and the non-persistent columella.

Type locality, Salzburg, Austria.

ILLUSTRATIONS:—Bry. Eur. l. c.; Braithw. Brit. Moss. Fl. **1:** *pl. 16K; Pl. 35.*
Part of Sullivant's Musc. Allegh. 142, which I have seen, is cited by Mrs. Britton as this species and it is reported in the Lesq. & James Manual p. 97 as from Ohio (Sullivant), which is probably the locality of his 142. This would appear to be the only known N. American locality. Through the courtesy of the New York Botanical Garden I have seen the scanty material from "limestone rocks, Gaspé, Quebec" which Mrs. Britton referred to *S. trifaria.* The material is very scanty but the one good capsule has no neck, the one stoma observed is on the lower part of the urn and the leaves are more like those of the Willoughby plant than those of the European *trifaria.* Mrs. Britton's notes accompanying this specimen give its spore measurements as 16–27 μ, too small for *trifaria.*

6. SELIGERIA RECURVATA (Hedw.) Bry. Eur. fasc. 33–36. *pl. 112.* 1846.

Grimmia recurvata Hedw. Stirp. Crypt. **1:** 102. *pl. 38.* 1787; Sp. Musc. 75. 1801.
Seligeria setacea [Wulf.] Lindb. Oefv. Sv. Vet.-Akad. Förh. **20:** 413. 1863.

Plants gregarious in small groups, small; stems 1–3, rarely 5 mm., long, simple or branched; leaves erect-open, the upper larger, 1–1.5 mm. long, gradually long-subulate from a lanceolate base; awn slender, entire, composed principally of the excurrent costa; cells at base hyaline, usually rectangular, shorter, minute and incrassate above; perichaetial leaves longer, broader at the base. Autoicous; antheridia in lateral buds; seta 3–4 mm. long, *flexuose and arcuate when moist;* capsule obovoid to pyriform, with a short stomatose neck, usually slightly narrower at the mouth when dry and empty, urn reaching 0.75 mm. long; operculum long-rostrate; exothecial walls thin, the cells longer than in the preceding species; peristome teeth reddish, smooth, lanceolate, obtuse or acute, with about 10 joints; spores about 10 μ, mature spring to early summer.

Type locality, Klagenfurt, Austria.

ILLUSTRATIONS:—Hedw. l. c.; Bry. Eur. l. c.; Braithw. l. c. *pl. 17C; Pl. 35.*
EXSICCATI:—Aust. Musc. Appal. 110; Allen, Mosses Cascade Mts. 16.
On moist shaded sandstone rocks; New York, New Jersey, Pennsylvania, Washington.

7. SELIGERIA CAMPYLOPODA Kindb.; Macoun, Cat. Can. Pl. **6:** 41. 1892.

Seligeria recurvata arcuata Lesq. & James, Man. 97. 1884.
Seligeria subcampylopoda Kindb.; Engler & Prantl, Musci (Ed. 1) 1176 (nomen nudum) 1909.

Plants small, gregarious; stems mostly 1 mm. or less in height, usually simple, upper leaves crowded, 0.75–1.5 mm. long, narrowly *oblong-lanceolate, acute to obtuse,* open-erect to recurved when moist; costa stout and mostly ending below the apex, somewhat rough on the back; margins entire or subserrulate; upper leaf cells minute, 6–10 μ in width, subquadrate to oblong or elliptical, incrassate, those near the base, rectangular, larger, clearer. Dioicous or monoicous; seta 1–3 mm. long, *typically recurved* but sometimes only slightly flexuose; capsules obovoid or pyriform, *not spreading at the mouth,* with a short neck; urn less than 1 mm. long; operculum long-rostrate; *exothecial cells thin-walled, irregularly oblong;* peristome reddish, deeply inserted; teeth lanceolate with 12–14 joints, sometimes split above or perforate; spores about 10 μ in diameter, mature in autumn.

Type locality, Owen Sound, Ontario.

ILLUSTRATIONS:—Bull. N. Y. Bot. Gard. **2:** *pl. 35; Pl. 35A.*
EXSICCATI:—Drumm. Musc. Am. 66 (as *Weisia Seligeri*); Sull. Musc. Allegh. 141.
On damp shaded rocks; Newfoundland to Montana; Ontario, New York, Ohio, Iowa. Apparently our most common species but rather infrequent.
The small size of these plants causes them to be overlooked and identification is often rendered difficult because the species grow intermingled.

8. SELIGERIA POLARIS Berggr. K. Sv. Vet.-Ak. Handl. **13**: 41. 1875

Blindia polaris Hag. D. K. N. Vid. Selsk. Skrift. **1910**: 99. 1910.

Plants in wide, rather compact cushions, largest of the genus, reaching 2.5 cm. in height but rarely over 5 mm.; stems irregularly much branched; leaves from a broadly ovate subclasping base abruptly or gradually narrowed to a stout awn; costa excurrent, stouter above, smooth; cells of lamina above the broad base quadrate; median basal oblong to sublinear, very incrassate, toward insertion becoming wider and rectangular; angular cells less colored and less incrassate but not inflated or forming auricles; perichaetial leaves larger, reaching 2 mm. in length. Seta somewhat curved when moist, rarely over 2 mm. long; capsule obovoid-globose with very short neck, erect and symmetric; urn 0.6–0.7 mm. high, contracted under the mouth and somewhat turbinate when dry and empty; operculum conic-rostrate; peristome teeth undivided; spores nearly smooth, 12–15 μ in diameter; mature in summer.

Type locality, Spitzbergen (Berggren). *Pl. 36.*

From Arctic N. America I have seen specimens from King Oscar Land and Ellsmere Land. The large size and black color are very distinctive. I have examined with care Berggren's Spitzbergen plants and those from Arctic America. The marked differentiation of alar cells emphasized by Brotherus in Engler and Prantl and in Laubmoose Fennoskandias (p. 43) and other authors, seems to be present in only a small proportion of the leaves and even if present it is difficult of demonstration as they are mostly left on the stem when the leaf is removed.

2. BRACHYDONTIUM Fürnr. Flora **10**[2]: Beil. 37. 1827.

Brachyodon Fürnr. l. c. Beil. 112.
Brachyodus Nees & Hornsch. Bryol. Germ. **2**[2]: 3. 1831.

Minute rock-growing plants with the leaf structure of *Ditrichum* and short truncate peristome teeth; only two known species.

Type species, *B. trichodes.*

1. BRACHYDONTIUM TRICHODES (Weber f.) Bruch, Paris, Index Bryol. (Ed. 2) **1**: 124. 1904.

Gymnostomum trichodes Weber f., Web. & Mohr, Arch. Syst. Nat. **1**: 124. 1804.
Brachyodus trichodes Nees & Hornsch. l. c. 5.

Plants small, gregarious and fruiting freely; stems about 1 mm. long; leaves crowded, imbricate, only slightly contorted when dry, 1–1.5 mm. long, subulate from an ovate or lanceolate clasping base; costa strong, constituting most of the slender awn, which is entire or faintly toothed; basal cells oblong-hexagonal to rectangular, thin-walled and clear, 3–7 : 1, becoming shorter and smaller, thicker-walled and obscure above, not papillose. Autoicous; antheridia in basal buds; seta 2–3 mm. long, yellowish; calyptra mitrate; capsule oblong, erect and symmetric, urn little more than 0.5 mm. long, striate when dry; operculum convex, slenderly rostrate, beak more than 0.5 length of urn; annulus large, of 2–3 rows of cells; peristome teeth irregularly truncate, short, scarcely appearing above the annulus, sometimes perforate, papillose; spores about 10 μ in diameter, mature in spring.

Type locality, Hartz Mts., Germany.

ILLUSTRATIONS:—Web. & Mohr, l. c. *pl. 4;* Bry. Eur. *pl. 115;* Braithw. Brit. Moss Fl. **1**: *17D; Pl. 36.*

Rare, and known in N. America from trap dykes in Tuckerman's Ravine, Mt. Washington, New Hampshire only. More common in mountains of British Isles and continental Europe.

This species and its relatives in the *Ditrichaceae* approach *Campylostelium* in the *Grimmiaceae*, while *Ditrichum* approaches *Barbula* in the *Pottiaceae.*

3. BLINDIA Bry. Eur. fasc. 33–36. 1846.

Plants large for the family; stems freely branching, with central strand; leaves lanceolate from a sheathing base; cells of basal angles inflated and forming auricles as in *Dicranum;* costa percurrent, of uniform cells; seta long-exserted; calyptra cucullate; capsules globose-pyriform to turbinate; peristome teeth 16, entire, smooth, often perforate; annulus lacking.

Type species, *B. acuta.*

1. Blindia acuta (Hedw.) Bry. Eur. l. c. *pl. 114.*

Weisia acuta Hedw. Sp. Musc. 71. 1801.
Blindia acuta flexipes R. & C. Rev. Bryol. **19**: 79. 1892.
Blindia flexipes Kindb. Eur. & N. Am. Bryin. 214. 1897.

Plants loosely cespitose, light to dark green, stems 1–8 cm. high; leaves crowded, suberect to slightly secund, 2–3 mm. long, lance-subulate from a broader sheathing base; upper and perichaetial more abruptly narrowed from an ovate base, concave, with entire incurved margins; costa strong, filling all the upper awn, sometimes slightly toothed at apex; basal cells linear, incrassate, those at insertion shorter and often colored, alar quadrate to short-rectangular and inflated, more highly colored. Dioicous; seta 3–10 mm. long, straight or curved; capsule pyriform, turbinate when dry and empty, with a short stomatose neck; urn with neck about 1 mm. long; exothecial cells small, irregular and thick-walled; operculum conic-rostrate; peristome teeth bright red, sometimes perforate and split at the apex; spores smooth, 10–18 μ in diameter, mature in early summer.

Type locality, Wales.

Illustrations:—Bry. Eur. l. c.; Limpr. Laubm. **1**: 474. *f. 149;* Braithw. Brit. Moss Fl. **1**: *pl. 17F;* M. H. M. *f. 41.*

Exsiccati:—Drumm. Musc. Am. 72; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 113; Aust. Musc. Appal. Suppl. 484; R. & C. Musc. Am. Sept. 362; Holz. Musc. Acro. Bor. Am. 11, 179; Grout, Musc. Perf. 120.

On wet rocks and ledges in cool moist elevated places; Greenland to Alaska, south to Vermont, New York, Michigan, Minnesota and Oregon. No. Carolina & Tennessee (Sharp)

Family DICRANACEAE.

Plants large to very small, usually growing in close sods or broad mats; stems mostly branching dichotomously, with central strand, for the most part densely leafy, usually more or less tomentose or radiculose; leaves straight and erect to curved and secund, sometimes crispate, smooth in the larger number of species, but often mamillose to papillose on one or both faces, for the most part broadly to narrowly lanceolate, often with a clasping base; costa of heterogenous cells (except subgenus *Arctoa* of *Dicranum*), usually mostly percurrent to excurrent, sometimes strongly ribbed on the back; alar cells strongly differentiated in many species, in others not at all; other basal cells usually elongated, the upper shorter, often isodiametric; cell walls often thickened and pitted. Dioicous or monoicous; seta much longer than the perichaetial leaves, erect or curved; capsules from erect and symmetric to arcuate and cernuous, sometimes plicate or strumose; peristome teeth single, rarely lacking, of 16 teeth from a low basal membrane, usually divided more than ½ the way down into two slender lanceolate to linear prongs, usually longitudinally striate below, often papillose above; operculum mostly rostrate; calyptra cucullate, never plicate or hairy, sometimes ciliate at base, often rough at apex.

Forms without split teeth are much like the *Seligeriaceae*, but such forms usually lack the strongly awned leaves. Species with awned leaves usually have split peristome teeth. The key will be given at the end of the family.

1. DICRANELLA Schimp. Coroll. Bry. Eur. 13. 1855.

Angstroemia C. Muell. Syn. **1**: 430. 1848. (in part).
Anisothecium Mitt. Jour. Linn. Soc. **12**: 39. 1869.
Microdus Schimp.; Besch. Mém. Soc. Sci. Nat. Cherb. **16**: 161. 1872.

Mostly small, earth-growing plants, gregarious or in wide close sods; stems erect or ascending, simple or branching, sparsely radiculose below; leaves smooth, smaller below and often rather distant, crowded above, straight and erect-appressed to spreading-squarrose or secund; abruptly subulate from a sheathing base to gradually narrowed from a non-sheathing base, mostly entire except at or near the apex; costa strong, mostly percurrent or excurrent, often filling the upper part of the leaf, sometimes vanishing 5 or 6 cells below the leaf apex, occasionally rough on the back near the apex; leaf cells subquadrate to linear, sometimes thick but not pitted; the basal longer and more clear, alar not differentiated (slightly so in *D. squarrosa*). Mostly dioicous; seta mostly erect and straight, yellowish when young, often dark red with age; capsule globose to oblong-cylindric, erect or cernuous, symmetric or often curved and strumose, smooth or plicate when dry

and empty; annulus large to wanting; peristome of 16 teeth, reddish mostly divided below the middle into two, rarely three, papillose prongs, usually vertically striate in the undivided part.

Type species, *Dicranella Grevilleana.*

KEY.

1.	Stem leaves squarrose from an enlarged, often clasping base	2.*
	Stem leaves not squarrose, without enlarged clasping base	5.
2.	Costa 40–60 μ wide, about 1/6 width of leaf base; leaves not long-decurrent	3.
	Costa about 50 μ wide, about 1/20 width of leaf base; leaves long-decurrent	*3. squarrosa.*
3.	Costa smooth on the back	4.
	Costa toothed on the back above	*1. Schreberi.*
4.	Capsules erect and symmetric; annulus present	*8. crispa.*
	Capsules inclined and unsymmetric; annulus lacking	*2. Grevilleana.*
5.	Leaves mostly with blunt rounded apex and costa clearly vanishing below it	6.
	Leaves mostly with acute apex and costa nearly percurrent to excurrent	7.
6.	Leaf apex dentate; median leaf cells quadrate to short-rectangular	*6. Hilariana.*
	Leaf apex mostly entire; median leaf cells 2–6 : 1	*7. Herminieri.*
7.	Capsules distinctly strumose	*11. cerviculata.*
	Capsules not distinctly strumose	8.
8.	Capsules erect and symmetric or nearly so	9.
	Capsules cernuous and unsymmetric	10.
9.	Capsules strongly plicate when dry and empty, with mouth oblique	*12a.* var. *orthocarpa.*
	Capsules nearly or quite smooth when dry and empty	*5. rufescens.*
10.	Capsules plicate when dry and empty	11.
	Capsules smooth or slightly wrinkled and mouth not oblique when dry and empty	*4. varia.*
11.	Mouth of empty capsules oblique; annulus poorly developed	*12. heteromalla.*
	Mouth of capsule not oblique; annulus well developed	12.
12.	Awn of two or three inner perichaetial leaves much shorter than the clasping base or sometimes lacking on the innermost	*10. stickinensis.*
	Awn of inner perichaetial leaves usually more than twice the length of the broad, less clasping base	*9. subulata.*

1. DICRANELLA SCHREBERI (Sw., Hedw.) Schimp. Coroll. Bry. Eur. 13. 1855.

Dicranum Schreberianum Hedw. Sp. Musc. 14. 1801.
Cynodontium canadense Mitt. Jour. Linn. Soc. **8**: 17. 1864.
Dichodontium canadense Lesq. & James, Man. 62. 1884.

Plants in bright to yellowish green tufts, 1–3 cm. high; lower leaves smaller, the upper larger, from a broad half-sheathing base gradually narrowed to a squarrose subulate-lanceolate limb, serrulate above, mostly acute; margins plane, sometimes serrulate to well below the middle; costa nearly percurrent to excurrent, about 50 μ wide; leaf cells in the upper part 6–12 μ wide and 2–3 : 1, mostly rectangular, shorter on the outer shoulders and much longer in the basal portion, 6–10 : 1 perichaetial leaves the longest, reaching 3.5 mm. long, clasping at base and more abruptly narrowed to the squarrose limb. Seta up to 1 cm. or more in length, erect, flexuous; capsule short-oblong, curved and cernuous, *smooth, not strumose,* contracted under the mouth when dry, urn 0.8–1.4 mm. long; operculum beaked, the beak usually little longer than the conical base; exothecial cells incrassate, oblong, 1–2 : 1; annulus lacking; peristome teeth red, usually divided about 1/3 the way down, longitudinally striate below, 0.4–0.5 mm. long, united at base; spores up to 18 μ in diameter, mature in autumn.

Type locality, Sweden.

ILLUSTRATIONS:—Bry. Eur. *pl. 53;* Braithw. Brit. Moss Fl. **1**: *pl. 16E;* Limpr. Laubm. **1**: *f. 114; Pl. 37.*
EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 61.

On damp clayey soil in fields and on sides of ditches; Pennsylvania to Oregon and British Columbia, north to Hudson Bay.

*Often the leaves of *2* are not strongly squarrose but widely spreading.

Varying greatly in the length, slenderness and amount of serration of the leaves, length of urn and operculum. The plants with long, slender and less serrulate leaves and longer leaf cells were called var. *occidentalis* by Austin, Bull. Torr. Club **6**: 344. 1879. This form is represented by Drumm. Musc. Am. 97 & Holz. Musc. Acro. Bor. Am. 152.

1a. Var. ELATA Schimp. Syn. (Ed. 2) 72. 1876.

Var. *lenta* (Wils.) Limpr. Laubm. **1**: 318. 1886.

Plants almost exactly resembling in appearance a depauperate *D. squarrosa*. Leaves short, broader at the apex, strongly serrate; leaf cells broader and shorter. Lake Mara, Sycamous, British Columbia, July 7, 1889 (Macoun).

ILL. Braithw. l. c. *f.* β.

Probably *D. Grevilleana* is best regarded as a subspecies of *D. Schreberi* because intergrading forms are frequent. Such forms are represented by Holz. Musc. Acro. Bor. Am. 588 and Macoun's New Brunswick plants.

2. DICRANELLA GREVILLEANA (Brid.) Schimp. Coroll. 13. 1855.

Dicranum Schreberi Grevilleanum Brid. Bryol. Univ. **1**: 450. 1826.
Dicranum Grevilleanum Bry. Eur. fasc. 37–40. *pl. 54*. 1847.
Anisothecium Grevillei Lindb. Utkast 33. 1878.

Differs from *D. Schreberi* in the less strongly squarrose leaves, nearly or quite entire, more abruptly contracted into a narrower flexuose awn, sometimes faintly toothed at apex. Capsules faintly striate when dry and empty, slightly strumose, beak of operculum about twice as long; spores up to 17 μ, mature in summer.

Type locality, Scotland.

ILLUSTRATIONS:—Bry. Eur. l. c.; Braithw. Brit. Moss Fl. **1**: *pl. 16D;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 11D; Pl. 37*.

EXSICCATI:—Macoun, Can. Musci 482; Holz. Musc. Acro. Bor. Am. 458, 588; Grout, Musci Perf. 137.

On damp soil in alpine regions; Idaho, Montana and Washington and north to Behring Sea. Macoun's plants from New Brunswick seem to belong to *D. Schreberi*. Keweenaw Co.

3. DICRANELLA SQUARROSA (Schrad.) Schimp. Syn. (Ed. 1) 71. 1860.

Dicranum squarrosum Starke, Jour. Bot. Schrad. **2**: 435. 1801.

Also placed in *Oncophorus* by Bridel, *Angstroemia* by C. Mueller, *Dichodontium* by Schimper, *Diobelon* by Hampe and *Anisothecium* by Lindberg and others.

Plants robust, light- or yellowish-green, cespitose, up to 10 cm. high; fertile 3–5 cm.; stems mostly simple; stem leaves strongly squarrose from a loosely clasping base, strongly decurrent, the sheathing base oblong, slightly narrowed to the lanceolate-oblong, concave limb, broadly obtuse and rounded to obtusely acute at the apex; margin often somewhat wavy and crenulate at the apex, plane; costa just above the base 50–65 μ wide, vanishing below the apex; leaf cells irregularly rectangular to oblong-hexagonal, median 8–15 μ wide, 40–65 μ long; basal cells about twice these dimensions; perichaetial leaves similar, the clasping base of the inner relatively longer. Seta reddish, erect, 1–1.5 cm. long; capsule obovoid to short-oblong, cernuous, unsymmetric, not strumose, brown, smooth; urn 1.5–2 mm. long; operculum long-conic, ⅔ length of urn; annulus lacking; peristome teeth dark red, reaching 0.45–0.7 mm. long, divided ⅓–½ the way down into 2–3 densely papillose prongs, striate below, from a basal membrane 3–4 cells wide; spores about 18 μ in diameter, maturing in autumn.

Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 52;* Braithw. l. c. *pl. 16F; Pl. 37*.

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 162, (Ed. 2) 245, both as *Meesia longiseta* var.

On wet gravelly soil in and near streams and bogs; Greenland, New Brunswick, Ontario, British Columbia and Alaska; south to New Hampshire and the Cascade Mts. of Washington. The Washington plants are the only ones found fruiting in N. America.

3a. Forma FLUITANS **n. f.**

Plantae semi-fluitantes, 8–10 cm. longae; folia 1.4 mm. longa, lanceolato-lingulata, prope recta, e basi non amplectente.

Plants in loose semi-floating masses, 8–10 cm. long; leaves erect-open, not clasping at base, nearly straight, lingulate-lanceolate, about 1.4 mm. long. Type, Grout, N. Am. Musci Pl. 458, Cape Breton Id. (Nichols).

Mr. H. N. Dixon was the first to place this anomalous form. Plants approaching it have been collected at Mt. Desert Id. and Franklin Co. Maine, but in these the leaves are subclasping and widely spreading.

4. DICRANELLA VARIA (Hedw.) Schimp. Coroll. Bry. Eur. 13. 1855.

Dicranum varium Hedw. Sp. Musc. 133. 1801.
Anisothecium rubrum Lindb. Utkast 33. 1878.
Dicranella Langloisii R. & C. Bot. Gaz. **15:** 39. *pl. 5A*. 1890.
Dicranella Howei R. & C. Bull. Herb. Boiss. **4:** 15. 1896.
Dicranella chrysea C. Muell. Hedwigia **37:** 230. 1898.

Plants gregarious or loosely tufted, dull- to bright-green; stems usually branched, 5–10 mm. long, sometimes more; lower leaves about 1 mm. long, erect-spreading or somewhat secund, long-lanceolate, the upper 1.5–2 mm. long, denticulate at apex, which is slender and acute to narrowly obtuse; upper lamina plane and bistratose; margin often recurved below; costa relatively large, about ⅕ the width of leaf at the base, nearly percurrent to slightly excurrent; median leaf cells linear to narrowly rectangular; 4–6 μ wide and 4–10 : 1; in the lower leaves 8–12 μ wide and 2-4 : 1; in the lower leaves of old stems, the leaves of young stems and the lower cells of all leaves about the same; perichaetial leaves the largest, broader and half sheathing at base. Dioicous; seta erect, 5–10 mm. long, reddish; capsule ovoid to short-oblong, more or less inclined and curved, when dry and empty smooth and markedly contracted below the mouth, not strumose; urn up to 1 mm. long, usually shorter; operculum rostrate; annulus lacking; peristome teeth red, up to 0.4 mm. long, longitudinally striate below, above papillose and divided ⅓–½ the length; spores finely papillose, about 18 μ in diameter, mature in late autumn.

Type locality, England.

ILLUSTRATIONS:—Bry. Eur. *pl. 57, 58;* Braithw. l. c. *pl. 16B;* M. H. M. *pl. 13*.
EXSICCATI:—Drumm. Musc. Am. S. States 50; Sull. Musc. Allegh. 164; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 47, (Ed. 2) 63; Aust. Musc. Appal. 78; Holz. Musc. Acro. Bor. Am. 151 (as *D. rufescens*), 30, 532; Baker, Pacific Coast Bryophytes 287; Grout, Musci Perf. 145.

Moist clay soil, banks of ditches and sometimes crevices of rocks. New Brunswick to Alaska and south to Mexico, Florida and Cuba; frequent.

The species is exceedingly variable in a number of characters but they are so little correlated that it is difficult to distinguish varieties. Some leaves may be filiform and with 2–3 teeth at the apex, otherwise entire; others may be narrowly obtuse and with several teeth at the blunt apex and distantly and finely toothed half way to the broader base; leaf margins revolute nearly to apex or rarely almost plane. Leaves of sterile plants are often triangular-lanceolate with leaf cells broader and about 2–3 : 1. The capsules are occasionally erect and symmetric, but others in the same tuft will have longer curved capsules; the operculum may be long conic to rostrate with beak as long as the conic part.

Holzinger, Bryol. **28:** 34 reports *D. humilis* Ruthe, Hedwigia **12:** 147. 1873 from Wisconsin (Musc. Acro. Bor. Am. 532). Dixon, according to Holzinger, regards *D. humilis* as equivalent to *D. varia* var. *tenella* (Bry. Eur.) Schimp.; Dixon, Handb. Brit. Mosses (Ed. 3), describes it as follows, "*Slender;* leaves usually falcate, *narrower*, areolation thin-walled, *laxer*, margin hardly recurved, remotely denticulate."

Limpricht says (Laubm. **1:** 323) that *D. humilis* is intermediate between *D. varia* and *D. rufescens* but nearer the latter.

Holzinger's 532 has narrower leaf cells than Rabenhorst's 1221, *D. humilis*, but may well be referred to it.

5. DICRANELLA RUFESCENS (Dicks., Sm.) Schimp. Coroll. Bry. Eur. 13. 1855.

Dicranum rufescens Sm. Engl. Bot. *pl. 1216;* 1803.
Anisothecium rufescens Lindb. Utkast 33. 1878.

Plants gregarious or in loose sods, often brownish or reddish; stems slender, little branched, up to 15 mm. high; lower leaves rather distant, spreading, the upper closer, longer, often somewhat secund, reaching 1 mm. long, narrowly lanceolate, acute ending in one cell, or more obtuse ending in 3–4 cells; margin plane,

entire except at apex or often faintly and distantly denticulate in the upper half; costa about 40 μ wide at base, nearly or quite percurrent in the *upper* leaves; leaf cells thin-walled, narrowly rectangular or with oblique end-walls, 6–8 μ wide up to 10 : 1, the marginal row often wider; perichaetial leaves similar but with a broader base, and longer reaching 1.75 mm. Seta red-brown, erect, 4–8 mm. long; capsule ovoid, erect, symmetric, smooth or slightly wrinkled and contracted below the mouth when dry and empty; urn 0.6–1 mm. long; annulus lacking; operculum long-conic to short-rostrate, ½–⅔ the length of the urn; peristome red, large, about 0.3 mm. long, divided nearly or quite ½ way down, striate below, strongly papillose above; spores slightly rough, 12–16 μ, mature in late autumn.

Type locality, England.

Illustrations:—Bry. Eur. *pl. 59;* Braithw. l. c. *pl. 16C;* M. H. M. *pl. 12.*

Exsiccati:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 48, (Ed. 2) 64; Aust. Musc. Appal. 74; Holz. Musc. Acro. Bor. Am. 505.

On moist shaded soil mostly bare of other vegetation; New Brunswick and Ontario to Alaska, south to Virginia and Washington, reported from Oregon. Apparently infrequent.

The western form represented by Holzinger's 505 has the cells of the upper lamina less distinctive in that they are narrower and less pellucid.

6. Dicranella Hilariana (Mont.) Mitt. Jour. Linn. Soc. **12:** 31. 1869.

Dicranum Hilarianum Mont. Ann. Sci. Nat. II. **12:** 52. *pl. 1. f. 3.* 1839.
Dicranum debile Wils. in Drumm. Musc. Am. S. States 51. 1841.
Dicranum tenuirostre Kunze; Schwaegr. Suppl. **4:** *pl. 108a.* 1842.
Angstroemia Liebmanniana C. Muell. Syn. **2:** 605. 1851.
Dicranella Liebmanniana Mitt. Jour. Linn. Soc. **12:** 32. 1869.
Campylochaetium mexicanum Besch. Mém. Soc. Sci. Cherb. **16:** 168. 1872.
Angstroemia mexicana C. Muell. Linnaea **38:** 630. 1874.
Angstroemia trematodontifolia C. Muell, l. c.
Dicranella debilis Lesq. & James, Man. 66. 1884.
Dicranella leptorhyncha R. & C. Bull. Soc. Bot. Belg. **31**[1]**:** 143. 1893.
Dicranella laxiretis R. & C. Rev. Bryol. **20:** 30. 1893.
Angstroemia pseudo-debilis C. Muell. Hedwigia **37:** 229. 1898.
?*Angstroemia Wrightii* C. Muell. Hedwigia **37:** 229. 1898.
Microdus cubensis Paris, Index Bryol. (Ed. 1) Suppl. 244. 1900.
Microdus debilis Besch.; Paris, Index Bryol. (Ed. 2) **3:** 236. 1905.
Microdus laxiretis Paris, Index Bryol. (Ed. 2) **3:** 237. 1905.

Plants in loose mats; stems 2–5 mm. long, simple or branching by innovations; stem leaves erect-spreading when moist, often somewhat secund, the upper larger, reaching 2 mm. in length, narrowly long-lanceolate, *gradually narrowed to a blunt serrulate apex,* sometimes subacute or nearly entire, concave, with the margins more or less recurved and serrulate below the apex; costa stout, occasionally rough on the back at the apex, ending below the apex; upper leaf cells subquadrate to short-rectangular, the lower much longer and clearer, 6–10 μ wide, 2–3 : 1; perichaetial leaves little different. Seta flexuous, 5–10 mm. long, yellowish when young, brownish when old; capsule nearly or quite erect, ovoid to short-oblong, light brown, becoming darker with age and oblong-cylindric when empty, slightly or not at all contracted under the mouth; operculum long-rostrate, nearly as long as the urn; annulus large; urn about 1 mm. long; exothecial cells hexagono-rectangular, 20–30 μ wide, 1–2 : 1; peristome teeth reaching 0.2 mm. in length, divided ⅔–¾ of the way, vertically striate below, papillose in indistinctly spiral lines above; spores finely papillose, 15–18 μ in diameter, mature in spring.

Type locality, southern Brazil.

Illustrations:—Sull. Icones Musc. *pl. 20;* Bot. Gaz. **30:** *pl. 3. f. 2; Pl. 38.*

Exsiccati:—Drumm. Musc. Am. S. States 51; Grout, Musci Perf. 73 (as *D. Herminieri*).

Southern U. S. to South America; common in peninsular Florida on moist banks of ditches.

The synonymy of this species and indeed of the Dicranaceae as a whole is based on Williams' treatment in the North American Flora **15**[2].

Of this species Williams remarks "The specimens included here under *D. Hilariana* are somewhat variable. The variation consists chiefly in the length of the upper leaves, the width of the leaf apex, and the amount of serration on the leaf border above and on the back of the costa near its termination. In all of the specimens at least some of the leaves have a rounded-obtuse, crenate or dentate apex."

7. Dicranella Herminieri Besch. Ann. Soc. Nat. VI. **3**: 180. 1876.

Dicranella Tonduzii R. & C. Bull. Soc. Bot. Belg. **31**[1]: 144. 1893.
Dicranella leptotrichoides R. & C. Bot. Gaz. **19**: 237. *pl. 21A*. 1894.
Angstroemia hydrophila C. Muell. Hedwigia **37**: 230. 1898.
Microdus hydrophilus Paris, Index Bryol. Suppl. 245. 1900.
Dicranella substenocarpa R. & C. Bull. Soc. Bot. Belg. **41**[1]: 11. 1905.
Microdus leptotrichoides Paris, Index. Bryol. (Ed. 2) **3**: 237. 1905.

Plants in size, habit and general appearance much like the last; leaves broader at the base and mostly narrower at the apex, averaging a little shorter, nearly or quite entire at apex; upper median leaf cells 4–7 μ wide, *2–6 : 1, narrowly rectangular to oblong-linear*, rather obscure, the lower cells larger, thinner-walled and clear, sometimes colored. Seta yellowish, turning dark with age, 6–9 mm. long; capsule ovoid, erect, symmetric, brown, becoming darker and oblong with age; peristome and spores about as in the preceding.

Type locality, Guadeloupe.

Illustrations:—Bot. Gaz. l. c.; *Pl. 37*.
Exsiccati:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 46b, (Ed. 2) 62; Aust. Musc. Appal. 468; Holz. Musc. Acro. Bor. Am. 129; Sull. Musc. Allegh. 177 (as *Trichostomum tenue*); Grout, Musci Perf. 71 (as *D. subinclinata*).

Moist banks and sides of ditches; South Carolina to Florida and Louisiana. Abundant in peninsular Florida and mixed with the last. Williams, l. c., p. 85, states that *Dicranella compacta* (Schimp.) Mitt. Jour. Linn. Soc. **12**: 37. 1869 is probably also a synonym and if so should replace the present name. Later he has expressed in a letter the doubt that *D. Herminieri* and *D. subinclinata* are distinct. If they are synonyms, then several others should be added to the list given above. The length and narrowness of the upper leaf cells varies greatly even on the leaves of the same plant. Thus far the plants I have seen from the U. S. correspond nearly to the above description and have seemed to be all one specific type. The stem leaves of this species are remarkably like those of *Ditrichum pusillum*. In some plants the leaves are almost triangular-lanceolate and these have shorter and broader leaf cells throughout, but these short cells are occasionally found in the leaves of the usual shape and are always in the shorter lower leaves. The leaf cells of *D. leptotrichoides* in the Bot. Gaz. plate are very inaccurately drawn.

8. Dicranella crispa (Hedw.) Schimp. Coroll. Bry. Eur. 13. 1855.

Dicranum crispum Hedw. Sp. Musc. 132. 1801.

Plants in small loose, yellowish tufts, reaching 1 cm. high, mostly less than 5 mm.; stems more or less branching; leaves rather distant, the lower much smaller, crisped-flexuose, spreading when moist, from a broad half-sheathing base abruptly to gradually narrowed to a slender, almost linear awn, 2–3 times the length of the base, acute at the apex; margins incurved, entire except at the apex; costa percurrent to excurrent; cells of the upper lamina linear, about 5 μ wide, up to 60 μ or more long, those of the base a little longer and about 12 μ wide; perichaetial leaves up to 3 mm. long, sheathing at base and more abruptly narrowed, often crenulate on the margin at the shoulder. Dioicous or occasionally with a short antheridial branch below the perichaetium; seta 1–1.8 cm. long, reddish; capsule *obovoid, short, thin-walled, when dry and empty obconic to turbinate, deeply and regularly striate, erect and symmetric;* urn about 0.75 mm. long; operculum nearly as long, with beak oblique or straight; exothecial cells incrassate, irregular, 2–3 : 1, a narrow band of smaller dark red cells about the mouth; annulus present, well developed; peristome teeth red, split nearly to the middle, up to 350 μ long, longitudinally striate below, papillose and paler at the apex; spores only slightly papillose, 17–20 μ, mature in late summer.

Type locality, Sweden.

Illustrations:—Bry. Eur. *pl. 504;* Limpr. Laubm. **1**: 321. *f. 115;* Braithw. l. c. *pl. 15D; Pl. 37*.
Exsiccati:—Drumm. Musc. Am. 102; Macoun, Can. Musci 504; Holz. Musc. Acro. Bor. Am. 587.
On moist sandy soil; Montana and Idaho to the Arctic; rare.

9. Dicranella subulata (Hedw.) Schimp. Coroll. 13. Bry. Eur. 1855.

Dicranum subulatum Hedw. Sp. Musc. 128. *pl. 34, f. 1–5*. 1801.
Dicranella secunda (Sw. 1795) Lindb. Musc. Scand. 26. 1879.

Plants in silky tufts, 0.5–2 mm. high; leaves flexuose, erect-spreading to more or less secund, the upper 2–3 mm. long, from an ovate-lanceolate subclasping base gradually narrowed to a channelled filiform awn,

entire or somewhat denticulate at and near apex; costa 40–45 μ wide at base, excurrent, sometimes longly so; *margins plane; upper leaf cells narrowly linear, 3–4 μ wide and up to 10 : 1,* basal twice as wide, a few shorter irregular cells at the shoulder; perichaetial leaves usually the longest, the inner shorter, *convolute-clasping, from an ovate or obovate base, abruptly to almost truncately narrowed to a filiform awn.* Seta red, 10–15 mm. long; capsule ovoid to short-oblong, mostly *inclined, curved and unsymmetric, not strumose, plicate when dry;* urn 0.8–1.2 mm. long; operculum long-rostrate, more than ½ the length of the urn, often equalling it; exothecial cells irregularly oblong, 1–3 : 1, with thick sinuous walls; annulus double; peristome teeth dark red-brown, about 350 μ long, split nearly ½ the way down, striate below, finely papillose above; spores finely papillose, 18–24 μ in diameter; mature late summer to autumn.

Type locality, Sweden.

ILLUSTRATIONS:—Hedw. l. c.; Bry. Eur. *pl. 60;* Braithw. l. c. *pl. 15E: Pl. 37.*

EXSICCATI:—Drumm. Musc. Am. 98; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 50, (Ed. 2) 66; Aust. Musc. Appal. 469; Holz. Musc. Acro. Bor. Am. 305.

Moist stony soil in cool or elevated regions; from subarctic N. America south to New Hampshire (White Mts.) and California.

Holzinger's 305 from the White Mts. has the leaves almost squarrose and slightly toothed at the apex, but the capsules are curved and unsymmetric. Williams, N. Am. Flora **15**[2]: 87, includes *D. curvata* (Hedw.) Schimp. as a synonym of *D. subulata.* The chief distinctions given by European authors are the erect and symmetric capsule of *D. curvata* and its denticulate leaves. Denticulate leaves are certainly found with curved capsules and the erect capsules alone are not sufficient for a specific distinction in this group of *Dicranella.* Consequently I agree with Williams.

This is distinguished from the common *D. heteromalla* by the nearly smooth awn, the more finely ribbed capsule and perhaps the red seta.

I do not find the color of the seta a very useful diagnostic character in this genus as its color varies so with age. Sometimes young setae in this species are distinctly yellow.

10. DICRANELLA STICKINENSIS **n. sp.**

Plantae dense caespitantes, 2 cm. altae, inferne tomento humoque compactae; folia e basi latiore longe subulata, margine integra; costa valida in subulam validam excurrens; folia perichaetialia interiora obtusa vel cum subula brevi.

Plants in dense yellow-green sods reaching 2 cm. high, the basal part brown, dead and compacted with soil; stems freely branching by innovations; leaves 1–1.5 mm. long, subclasping at base, erect when moist, somewhat contorted in the upper part when dry, from a broader base gradually to rather abruptly contracted to a stout rigid entire awn; margins plane, entire; costa stout, percurrent to strongly excurrent in the upper and perichaetial leaves; perichaetial leaves from an ovate base abruptly contracted to a stout awn 1.5–2 times the length of the base in the outer, in the inner convolute-clasping with awn shorter than the base, or often the innermost broadly pointed and obtuse. Sporophyte like that of *D. subulata* except that the capsules are suberect and that the basal part of the peristome teeth is coarsely papillose, striate at base of forks; spores not fully developed, nearly smooth, up to 18 μ. Type from Stickine Glacier, British Columbia, Aug. 8, 1916 (W. S. Cooper). *Pl. 27B.*

Type in herb. A. J. G., cotypes at the N. Y. Botanical Garden and in herb. H. N. Dixon.

Except for the peristome markings the sporophyte would pass for the form of *D. subulata* that is sometimes called *D. curvata,* but the stem and perichaetial leaves are very different and remind one strongly of those of *Ditrichum lineare.*

11. DICRANELLA CERVICULATA (Hedw.) Schimp. Coroll. Bry. Eur. 13. 1855.

Dicranum cerviculatum Hedw. Sp. Musc. 149. 1801.
Dicranella polaris Kindb. Ottawa Nat. **5**: 195. 1892.
Dicranella pusilla (Hedw.) E. G. Britton, N. Am. Flora **15**[2]: 87. 1913.

Plants in dense yellow-green mats; stems simple, rarely over 1 cm. long; stem leaves erect-spreading, flexuous, more or less secund; upper stem leaves about 2 mm. long, half-sheathing at base, lanceolate-subulate, concave, channelled above, somewhat serrulate on the upper margin to almost entire; costa wide and strong, ⅓ the width of leaf base but not so clearly defined as in *D. heteromalla,* gradually wider to the shoulder of the leaf, then gradually narrowed and excurrent, denticulate at apex; upper cells of the narrow lamina 4–5 μ wide, 6–10 : 1, narrowly rectangular; basal nearly twice as large; cells of the lower leaves and of the

innovations much shorter, resembling those of *D. heteromalla;* perichaetial leaves larger with a broader more clasping base, more abruptly narrowed. Seta yellowish, 1 cm. or more in length; capsule short-ovoid, curved, inclined and unsymmetric, *plainly strumose,* faintly plicate when dry and empty, 1 mm. long, with a beaked operculum of an equal length; annulus imperfect, of a single row of inconspicuous cells remaining more or less attached to the operculum or urn; peristome teeth and exothecial cells as in *D. heteromalla;* spores 15–21 μ, mature late summer to autumn.

Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 56;* Braithw. l. c. *pl. 16A;* M. H. M. *f. 40.*

EXSICCATI:—Sull. Musc. Allegh. 167; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 49, (Ed. 2) 65, 66 (in part); Holz. Musc. Acro. Bor. Am. 431.

On moist peaty banks and sides of ditches, bare moist soil, etc.

Arctic America to New York and New Jersey, west to British Columbia; rare.

11a. Var. AMERICANA Grout, M. H. M. 92. 1904.

Leaves more slender, neck of capsule slightly swollen, scarcely strumose; spores mature late autumn to winter. "Wet soil about iron deposit, Katahdin Iron Works, Maine, Nov. 5, 1898. (E. D. Merrill.)

This is probably the same as the European var. *pusilla* (Hedw.) Schimp. That is described as shorter with the leaves smaller and suberect. Which is not the case with the Maine plants, but the essential character seems to be the lack of the goiter.

12. DICRANELLA HETEROMALLA (Hedw.) Schimp. Coroll. Bry. Eur. 13. 1855.

Dicranum heteromallum Hedw. Sp. Musc. 128. 1801.
Campylopus Henrici R. & C. Bot. Gaz. **13:** 197. 1888.

Plants usually in wide dark-green mats, sometimes yellowish; stems freely branched, usually by innovations, 1–4 cm. long; leaves usually falcate-secund, rarely erect-spreading, 2–4 mm. long, ovate-lanceolate to lanceolate, widest at insertion and gradually narrowed to a filiform rough channelled awn consisting chiefly of the stout, more or less excurrent costa, *which often occupies ⅓ the width of the leaf base and is rough on the back and sides from the middle of the leaf upwards,* rarely near the apex only; margins plane; cells at the leaf base rectangular, up to 12 μ wide, 2–6 : 1, the upper rectangular-oblong, narrower, 1.5–2 : 1; perichaetial leaves with a broader obovate clasping base, more abruptly narrowed to an awn 4–6 times as long as the clasping base and with lower cells larger than in the stem leaves. Seta erect or curved, 5–15 mm. long, rarely up to 3 cm., yellow when mature, sometimes dark red with great age; capsule more or less inclined and unsymmetric, ovoid to oblong-cylindric, *strongly sulcate only when dry and empty, with mouth oblique due to the capsules contracting below the mouth much more strongly on the under side;* urn 1–1.5 mm. long; operculum long-rostrate, about the same length; *annulus poorly developed;* exothecial cells, except at the mouth, oblong-flexuose, 2–5 : 1, incrassate; peristome teeth about 0.4 mm. long, dark red, typically divided to the middle, strongly striate longitudinally and papillose below, the prongs coarsely papillose and somewhat trabeculate; spores smooth, about 15 μ in diameter, mature autumn to winter.

Type locality England.

ILLUSTRATIONS:—Hedw. l. c. *pl. 30;* Bry. Eur. *pl. 62;* M. H. M. *pl. 11.*

EXSICCATI:—Drumm. Musc. Am. 95, 96; S. States 53, 54; Sull. Musc. Allegh. 165, 166; Sull & Lesq. Musc. Bor. Am. (Ed. 1) 51, (Ed. 2) 67; Aust. Musc. Appal. 79; Holz. Musc. Acro. Bor. Am. 6, 28, 530, 5 (as *D. cerviculata*); Grout, Musci Perf. 7; Allen, Mosses Cascade Mts. 11, 11a.

On moist banks in shaded places, very common; Newfoundland to Alaska, south to Florida, California and Central America.

The roughness of the back of the costa, the width and coarseness of the marginal serrations as well as their extent, vary greatly. Holzinger's 531, issued as var. *stricta,* has the leaves only a little less secund than usual, but the leaves are coarsely serrate and the serrations in diminished size extend well towards the broader base. This type of marginal lamina seems characteristic of the Pacific Coast plants.

The length of the leaves also varies considerably, those of the west averaging longer than those of the eastern plants. The seta nearly always appears lateral due to the innovations. The teeth of the peristome are very persistent but they gradually lose their markings of striae and papillae with age. In moist mountain regions the capsule is often tilted back on the curved seta so that the operculum is nearly vertical as shown in the Bry. Eur. plate *f. 1 & 15.*

12a. Var. SERICEA Schimp. Syn. (Ed. 2) 78. 1876.

Plants short, in bright green or yellowish tufts, soft and silky; leaves narrower, erect-spreading to subsecund. Not very distinct; occasional.

12b. Var. ORTHOCARPA (Hedw.) Paris, Index Bryol. 330. 1895.

Dicranum orthocarpum Hedw. Sp. Musc. 131. *pl. 30.* 1801.
Dicranella Fitzgeraldi R. & C. Bot. Gaz. **13:** 197. *pl. 13.* 1888.

Leaves shorter; capsules erect and symmetric or nearly so, with mouth little or not at all oblique when dry and empty; urn shrunken and coarsely furrowed rather than plicate when empty.

Type from Lancaster, Pennsylvania.

ILLUSTRATIONS:—Hedw. l. c.; Bot. Gaz. l. c.; M. H. M. *f. 39*
EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 52, (Ed. 2) 68; Aust. Musc. Appal. 80; Holz. Musc. Acro. Bor. Am. 128; Grout, Musci Perf. 143.

My remarks in M. H. M. p. 91, are in error, as the type is from the lowlands. The variety ranges from the Province of Quebec to Georgia and westwards to Indiana or farther. It is the common form along the Middle Atlantic seaboard, where in swampy woods it covers square feet in area. The stunted form found at the higher altitudes of the New England mountains does not, in my opinion, belong here. The capsules are usually more or less inclined and finely plicate when dry and empty. Their variations are due to habitat conditions. The frequent intergradations with the typical form do not indicate specific rank for this variety.

EXCLUDED SPECIES.

According to Williams, N. Am. Flora **15**[2]: 93, the following should be excluded:

Dicranella cerviculatula Kindb. Ottawa Nat. **5:** 195. 1892, is *Dicranum hyperboreum* (Gunn.) Smith.

Dicranella parvula Kindb., Macoun, Bull. Torr. Club **16:** 91. 1889, is *Didymodon parvulus* (Kindb.) E. G. Britton.

PLATE 1. *A. Andreaea rupestris*, var. β *acuminata* (from Bry. Eur. *pl. 624*). 1, 2, plants × 1; 3–6, stem leaves; *6a*, cells of leaf apex × 100; 7, 8, middle and inner perichaetial leaves respectively; 9, capsule; 10, calyptra.

B. Andreaea Blyttii (from Bry. Eur. *pl. 635*) 4–7, leaves much magnified; 4*a*, 4*b*, cells of apex and base respectively.

C. Andreaea rupestris var. *alpestris* (from Bry. Eur. *pl. 626*). 17, 21, leaves; 8*a*, apical cells; 8*bm*, basal marginal cells; 8*bn*, basal median cells.

Leech & Simson ad Sculpt

PLATE I.

PLATE II.

PLATE 2. *A. Andreaea nivalis* (from Bry. Eur. *pl. 636*). 5, 6, leaves; 12, perichaetium with sporophyte; 13, perichaetial leaf; 5*a*, 5*b*, basal and apical cells respectively; *x*, cross sections of leaf; 10*b*, apex of leaf showing large papillae; 15, 16, open capsules.

B. Andreaea obovata (from Bry. Eur. *pl. 627*.) Upper left, part of fertile plant much enlarged; 16–18, perichaetial leaves; 11, portion of stem showing clasping leaf base; 6*a*, 6*b*, leaf apex and base showing cells; 21, open capsule.

PLATE 3. *Tetraphis pellucida.* (From Bry. Eur. *pl. 196.*) 1, 2, 3, plants × 1; 1*b*, fertile plant enlarged; 5, sterile plant bearing gemmiferous cups; 8, lower leaves; 9, upper median leaf; 12, 13, perichaetial leaves; 10*a*, apex of stem leaf; 15, capsule with calyptra; 17, deoperculate capsule showing peristome; 28, 29, gemmae; *x*, cross section of calyptra.

Tetraphis Browniana. (From Bry. Eur. *pl. 197.*) 1, 2, plants × 1; 3, frondiform leaves magnified; 4, a single one from 3 greatly magnified; 9, 10, 11, 12, perichaetial leaves; 15, capsule covered by the calyptra; 18, capsule; 19, peristome.

Tetraphis Browniana var. *repanda.* 1*b*, fertile plant enlarged, showing flagelliform branch; 4, flagelliform branch much enlarged.

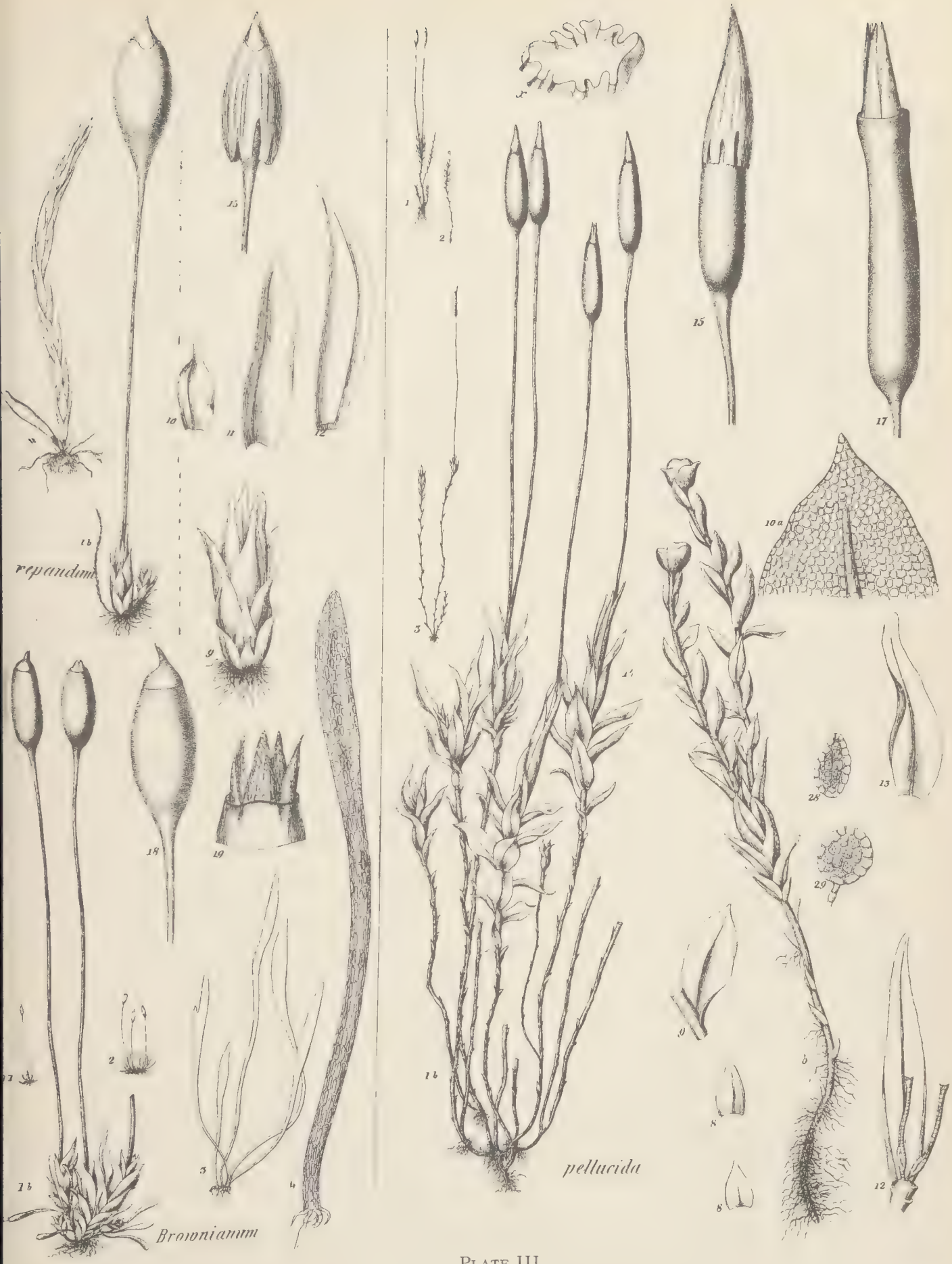


PLATE III.

PLATE IV.

PLATE 4. *A. Fissidens manateensis* (from micro-photographs by A. T. Beals). 1, portions of leaves and antheridial branch × 25; 2, plant with sporophyte × 4; 3, small plant with sporophyte beginning to show and with upper and perichaetial leaves in fine condition × 4.

B. Tetraphis geniculata (from Bry. Eur. Suppl., *Tetraphis, pl. 1*). 1, plants × 1; 2, upper part of plant enlarged; 4, 5, upper stem leaves; 6, perichaetial leaves; 8, leaf of sterile plant; 7*a*, 7*b*, areolation of apex and base of perichaetial leaf; 8*a*, areolation at apex of 8; 15, portion of seta much enlarged.

PLATE 5. *Fissidens exiguus* (from Jennings, Mosses W. Pa., *pl. 11*). P, plant enlarged; 1, leaf; 1*b*, cells of leaf base; 1*a*, cells of leaf apex; 1*c*, cells of margin of upper vaginant lamina; 8, exothecial cells with part of peristome tooth; *t*, upper part of a prong of tooth showing spiral thickening; *sp*, spore.

Fissidens bryoides var. *incurvus* (from Jennings l. c. *pl. 10* as *F. bryoides*). Description as for the preceding except that 1*b* shows the base of the dorsal lamina only.

Fissidens minutulus (from Jennings l. c.). Description as for the preceding.

C. Fissidens viridulus (from Braithw. Brit. Moss Fl. **1**: *pl. 12**). *a*, plants × 1; *a**, same magnified; 1, leaf; 1*a*, leaf apex; 3, antheridial bud; 5, capsule.

H. Fissidens viridulus var. *tamarindifolius* (from Braithw. l. c.). Description as for the preceding.

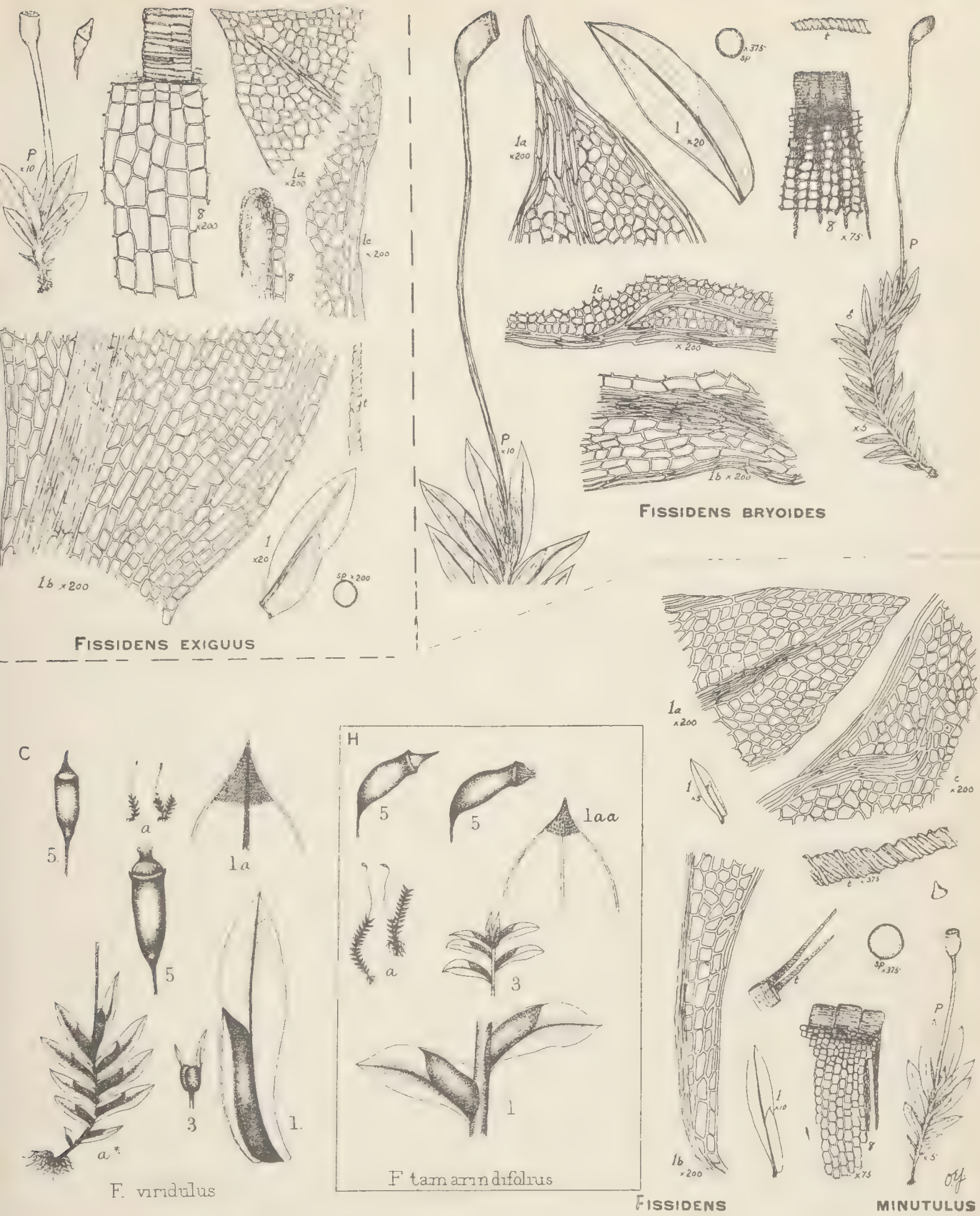
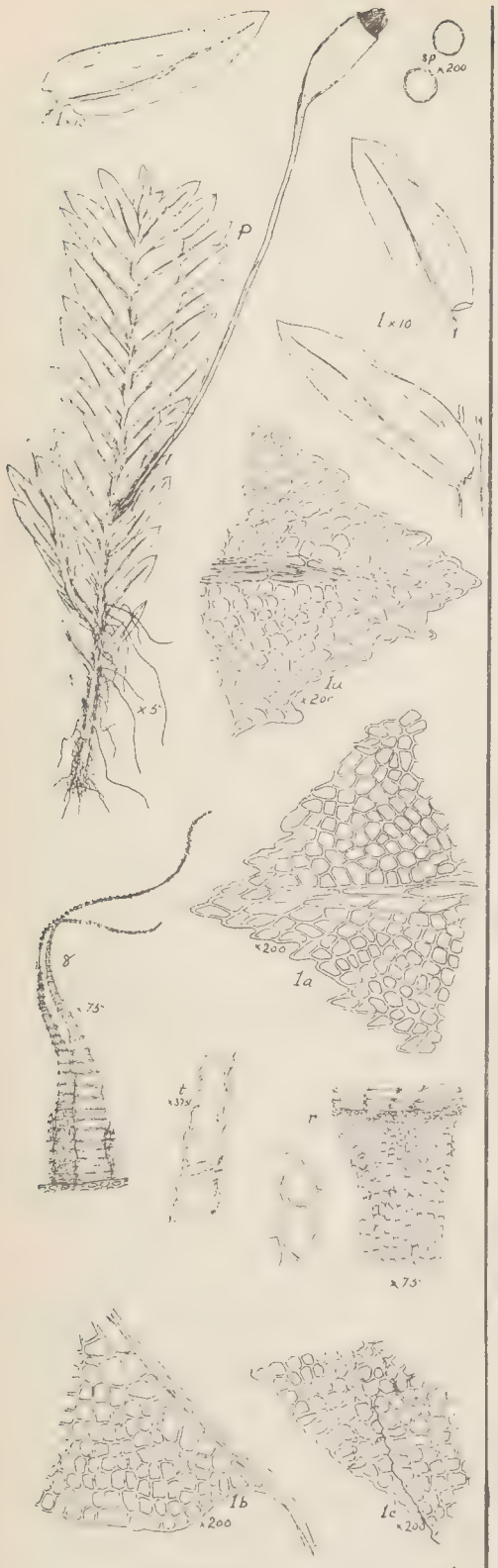
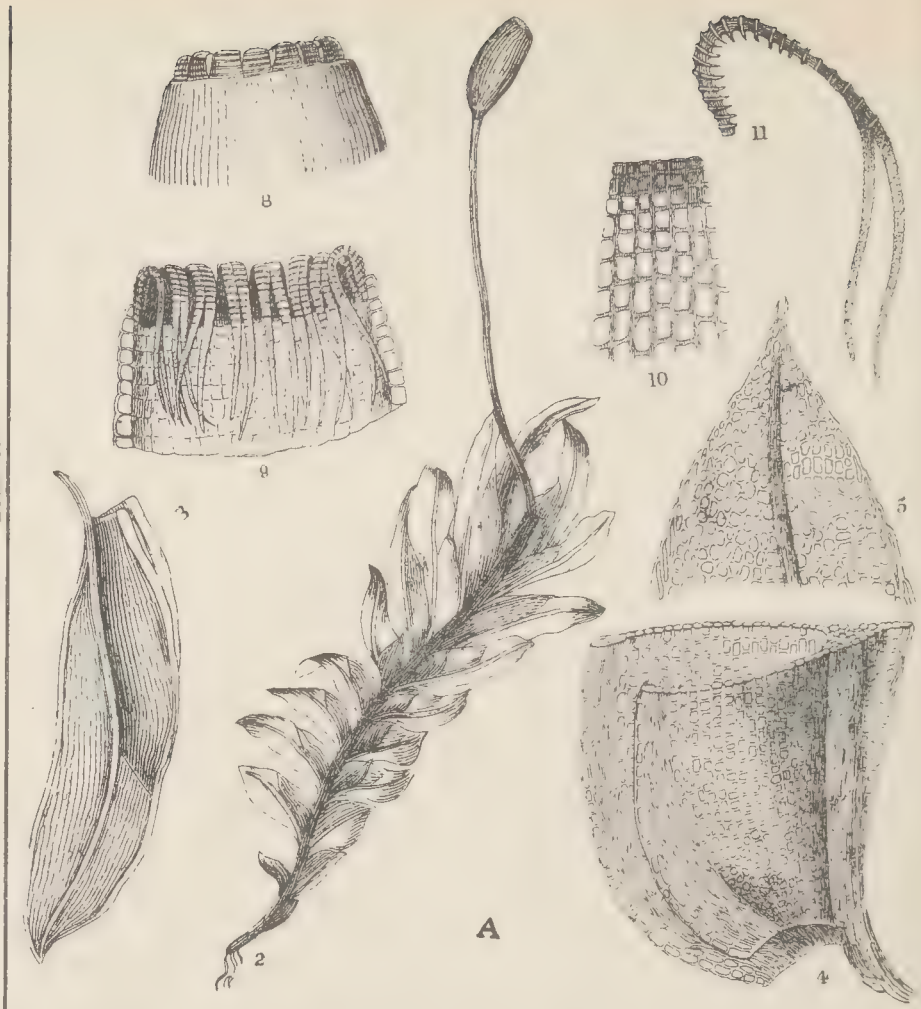

FISSIDENS EXIGUUS
FISSIDENS BRYOIDES
F. viridulus
F tamarindifolius
FISSIDENS MINUTULUS

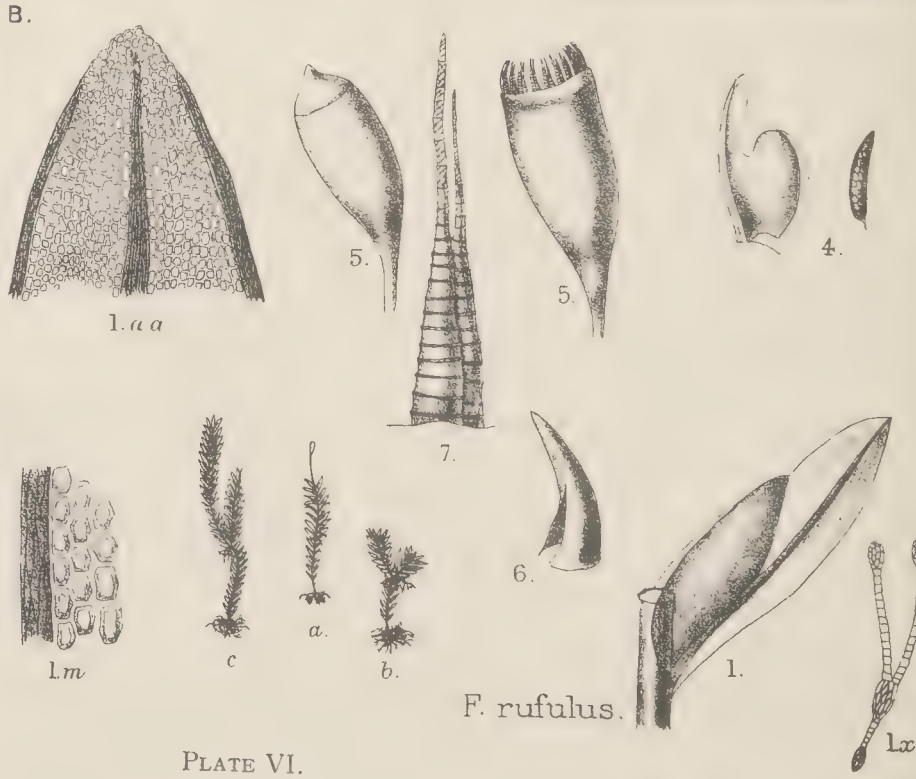
PLATE V.



FISSIDENS CRISTATUS



B.



F. rufulus.

PLATE VI.

PLATE 6. *Fissidens cristatus* (from Jennings, Mosses of W. Pa. *pl. 11*). 1, leaves; 1*a*, leaf apices, 1*b*, base of dorsal lamina; 1*c*, leaf cells at summit of vaginant lamina; 8, tooth of peristome; *p*, entire plant; *r*, exothecial cells; *sp*, spores; *t*, portion of tooth showing spiral thickening.

A. *Fissidens limbatus* (from Sull. Pacific R. R. Reports **4**: *pl. 1*). 2, plant much enlarged; 3, leaf; 4, leaf base showing cells; 5, leaf apex; 8, 9, mouth of capsule showing the moist teeth infolded; 10, exothecial cells near the capsule mouth; 11, peristome tooth.

B. *Fissidens rufulus* (from Braithw. Brit. Moss Fl. **1**: *pl. 11B*). *a*, *b*, *c*, plants × 1; 1, leaf; 1*x*, cross section of same; 1*aa*, leaf apex; 1*m*, median cells near the costa; 5, capsules; 6, calyptra; 7, peristome tooth; 4, perigonial leaf and antheridium.

PLATE 7. *A. Fissidens Garberi.* 1, plant slightly enlarged; 2, plant × 10; 3, 4, leaves × 20; 5, leaf apex × 200; 6, base of perichaetial leaf showing border on vaginant lamina × 200; 7, upper margin of leaf × 400 (the sharply crenulate margin due to projecting papillae is not correctly shown); 8, capsules × 13; 9, cross section of leaf × 200.

B. Fissidens obtusifolius kansanus. 1, leaves × 20; 2, leaf base × 200; 3, margin of vaginant lamina of perichaetial leaf × 200.

C. Fissidens subbasilaris. 1, leaves × 20; 2, leaf apex × 150; 3, cross section of leaf × 200.

D. Fissidens tortilis. 1, plant × 3; 2, leaves × 20; 3, leaf base × 200; 4, leaf apex × 200; 5, capsules × 20. Drawn from the Pineola, Florida, plants.

E. Fissidens Kegelianus. 1, plants × 3; 2, leaves × 20; 3, leaf base × 400; 4, leaf apex × 200; 5, deoperculate capsules; 6, operculate capsule × 20; 7, exothecial cells × 200. (All drawings by Seville Flowers.)

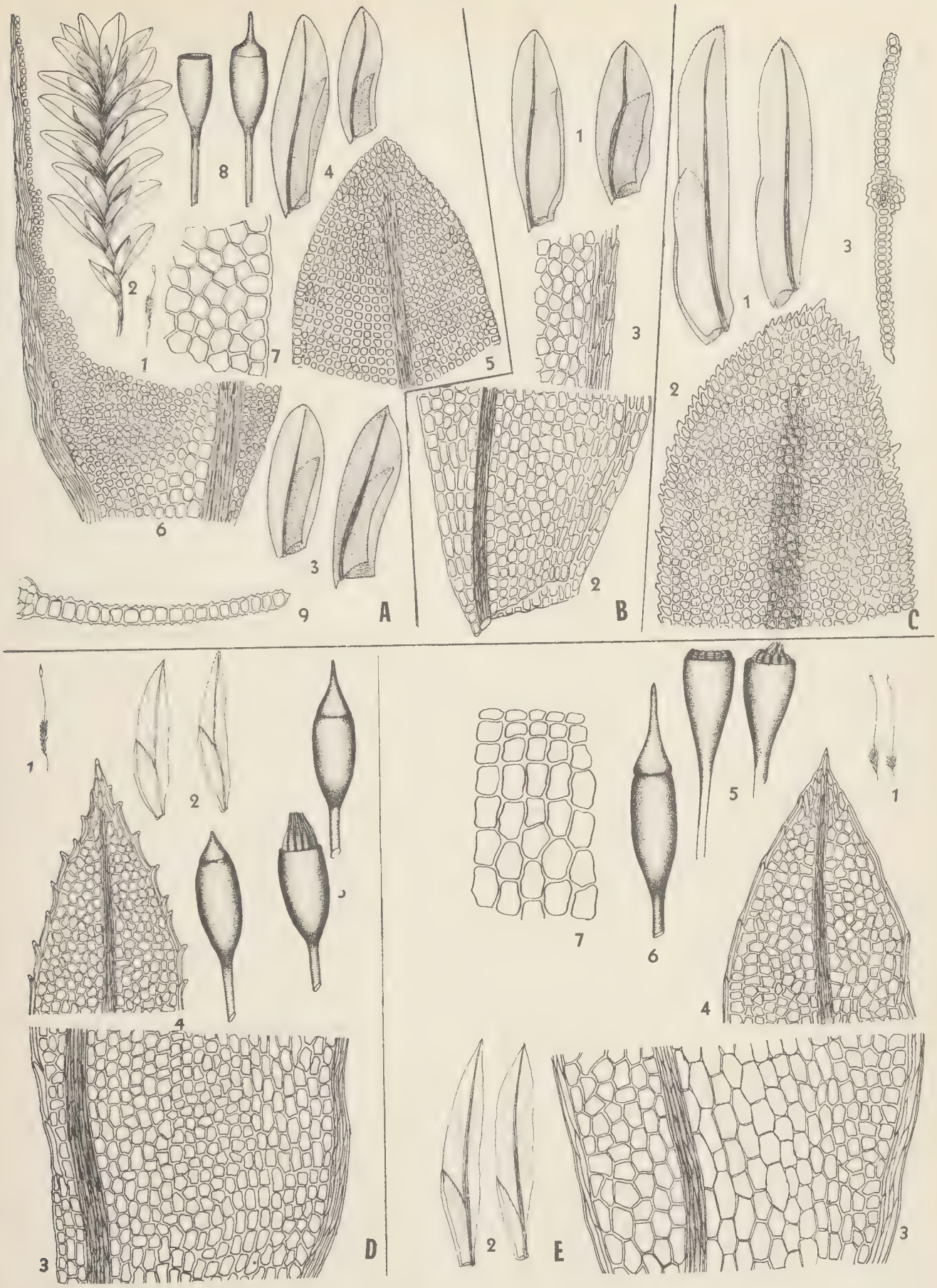


PLATE VII.

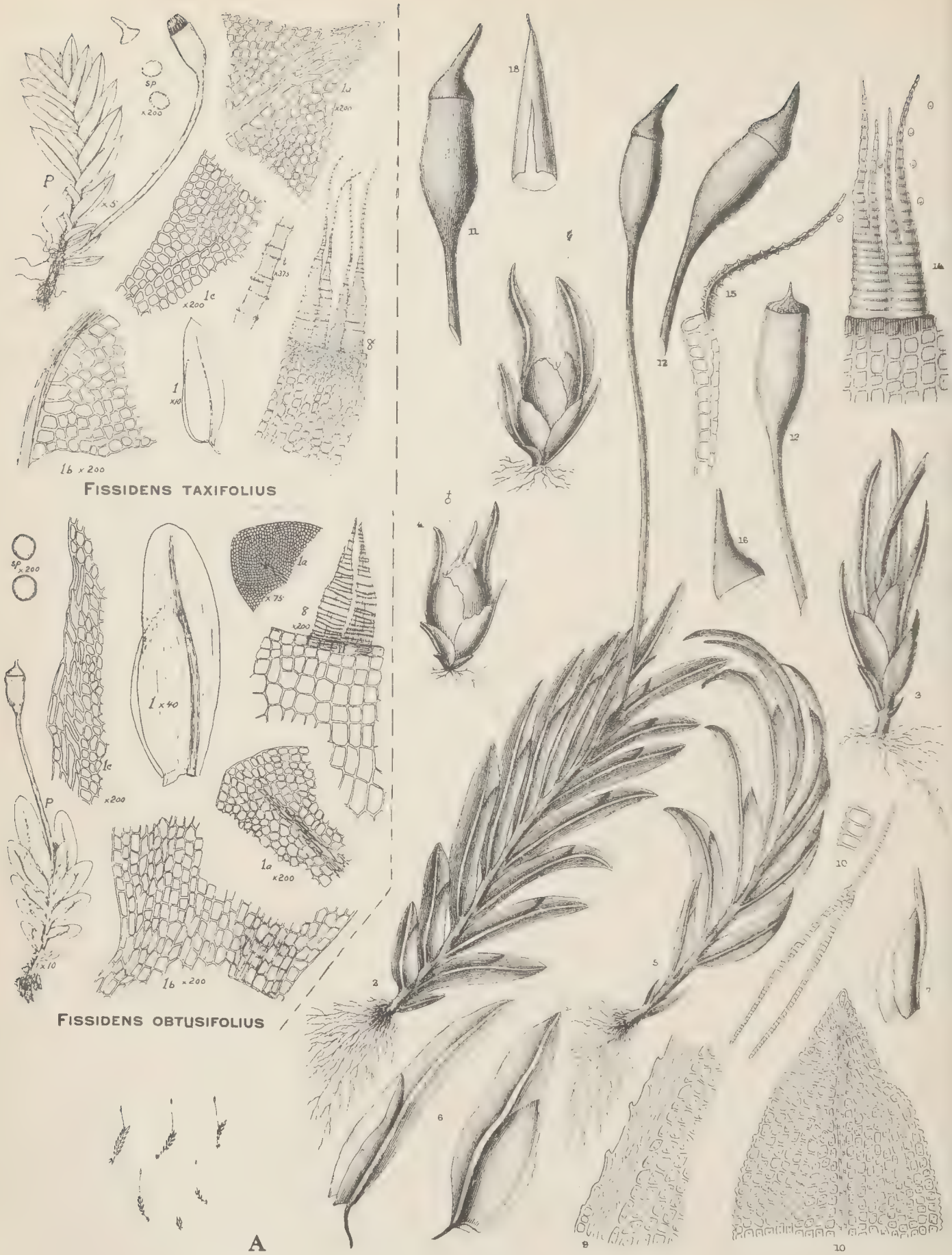


PLATE VIII.

PLATE 8. *Fissidens taxifolius* (from Jennings, Mosses W. Pa. *pl. 11*). *P*, plant enlarged; 1, leaf; 1*a*, cells of leaf apex; 1*c*, cells at apex of vaginant lamina; 1*b*, cells at base of dorsal lamina; 8, exothecial cells and peristome tooth; *t*, portion of tooth; *sp*, spores.

Fissidens obtusifolius (from Jennings, l. c. *pl. 10*). Description as for the preceding.

A. *Fissidens Ravenelii* (from Sull. Icones Musc. *pl. 25*). 1, plants × 1; 2, fruiting plant much magnified; 3, perichaetial leaves; 4, antheridial buds; 5, sterile plant; 6, leaves; 7, perigonial leaf; 9, border of vaginant lamina of perichaetial leaf; 10, leaf apex and cross section of leaf; 11, 12, capsules; 13, deoperculate capsule; 14, 15, peristome teeth; 16, operculum; 18, calyptra.

PLATE 9. *A. Fissidens Closteri* (Sull. Icones Musc. Suppl. *pl. 29*). 2, plant enlarged showing minute calyptra in position; 4, base of plant more enlarged showing antheridial bud; 6, perigonial leaf; 7, base and apex of leaf showing cells; 9, deoperculate capsule with dry peristome; 10, operculum.

B. Fissidens arcticus (from Bryhn, Bryophyta in Itinere Polari Norvagorum Secundo Collecta *pl. 1*).

C. Fissidens pauperculus (from Erythea, **2**: *pl. 1*). *a*, entire fertile plant; *b*, capsules; *ee*, apex of leaf showing cells and portion of leaf above the vaginant laminae; *f*, cells near base of vaginant lamina.

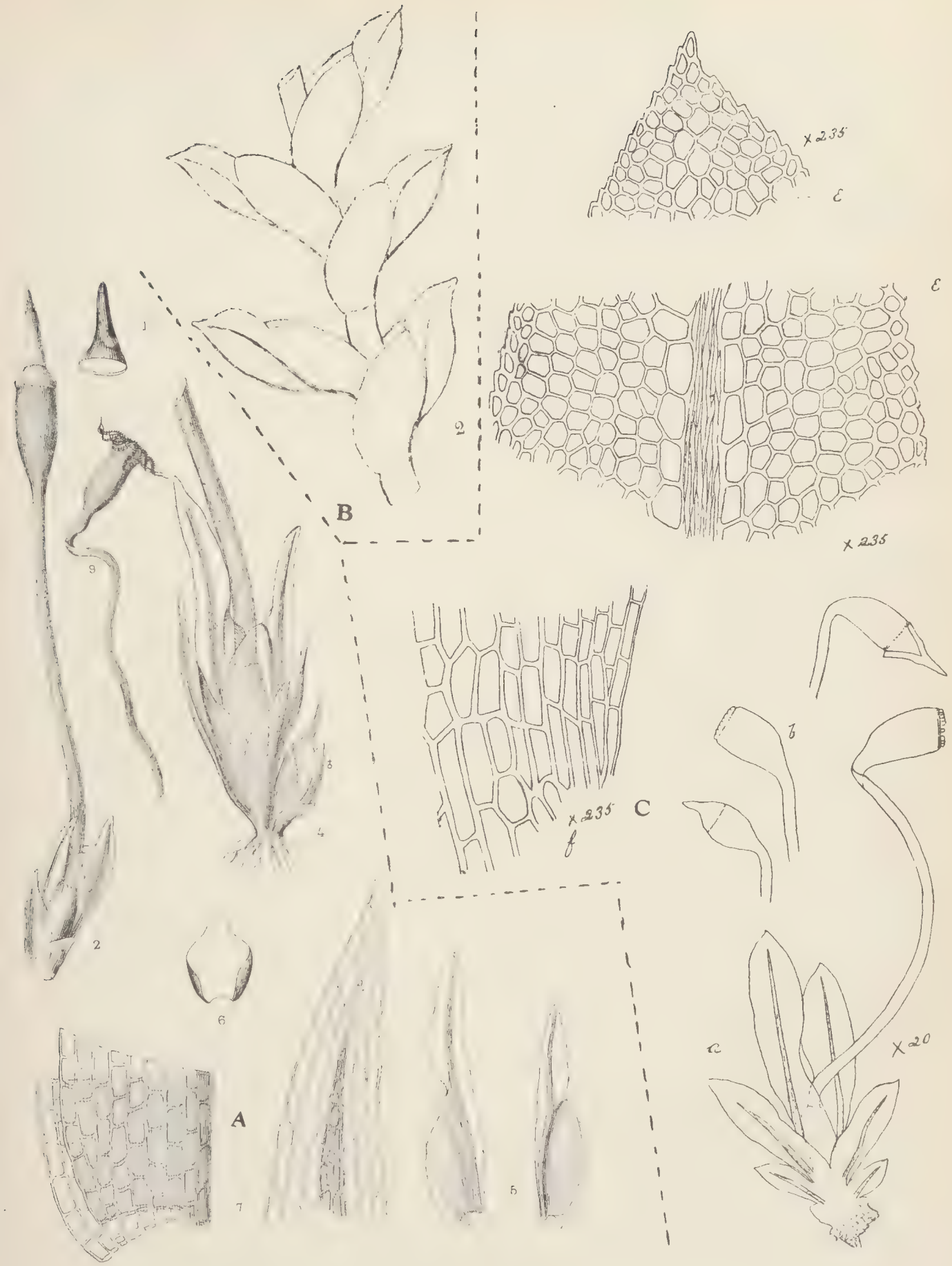
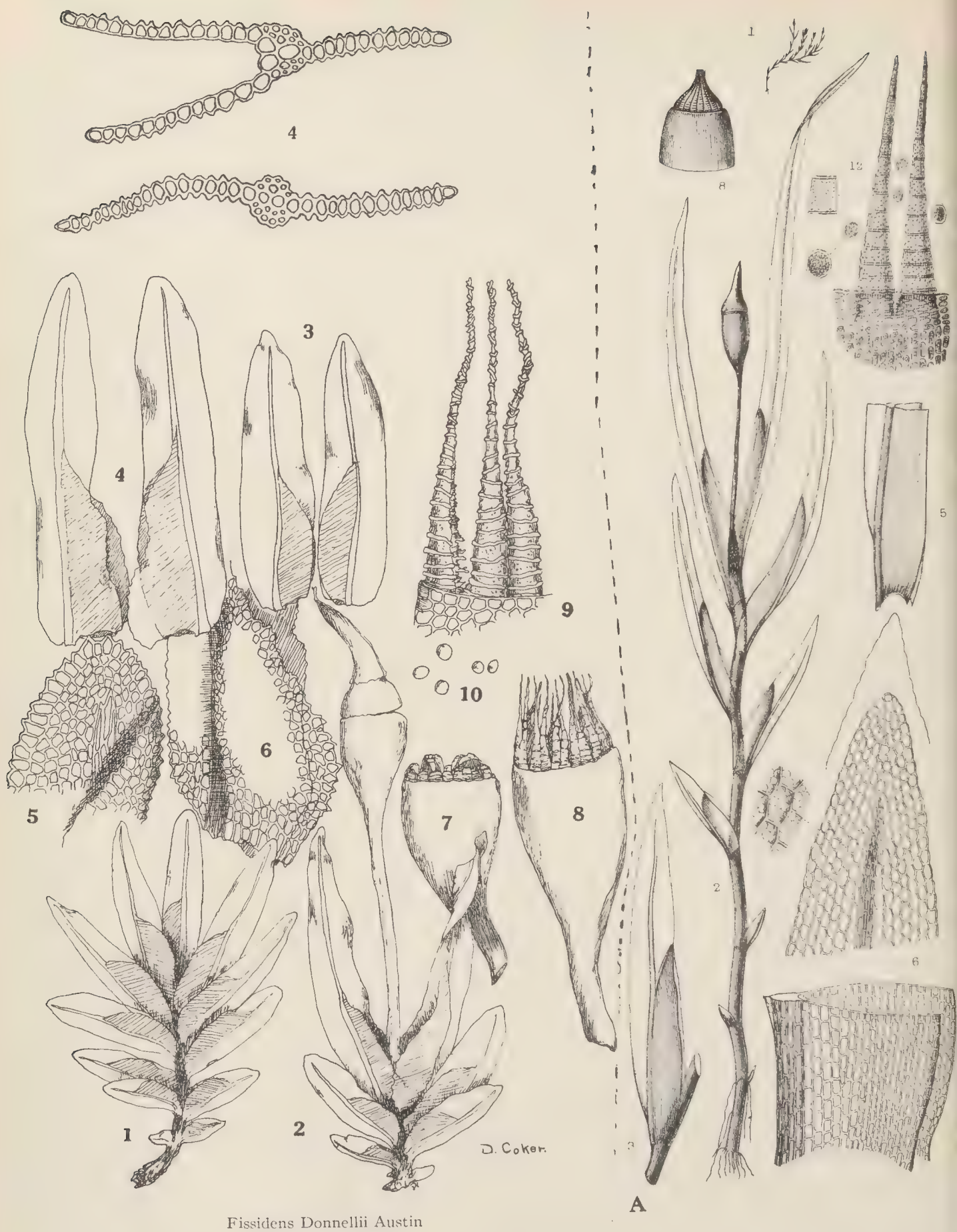


PLATE IX.



Fissidens Donnellii Austin

PLATE X.

PLATE 10. *Fissidens Donnellii* (from Jour. N. Y. Bot. Garden **20:** *pl. 233*). 1, sterile plant; 2, fertile plant showing long perichaetial leaves; 3, leaves showing unequal vaginant laminae; 4, perichaetial leaves; 4′, cross sections of leaf, the lower above the vaginant laminae; 5, apex of leaf showing larger, irregularly serrate marginal cells and profile of dorsal surface with projecting, sharply mamillose cells; 6, base of leaf showing cell structure; 7, capsule with moist incurved peristome; 8, the same with dry erect peristome; 9, peristome teeth showin gmarkings; 10, spores.

A. Fissidens Hallianus (from Sull. Icones Musc. Suppl. *pl. 28*). 1, plants × 1; 2, fruiting plant enlarged; 3, leaf; 5, basal part of leaf; 6, base and apex of leaf showing cell structure; 8, capsule mouth with peristome; 12, peristome teeth and spores, showing insertion of teeth below capsule mouth.

PLATE 11. *A. Fissidens polypodioides* (from Sull. Icones Musc. *pl. 27*). 1, plants ♂ and ♀ × 1; 3, leaf; 7, cells of leaf apex; 8, 9, 10, capsules; 11, peristome teeth and part of annulus; 12, section of peristome; 13, 14, antheridial buds.

B. Fissidens hyalinus (from Sull. l. c. *pl. 21*). 2, 3, plants enlarged; 6, leaf; 8, 9, leaf cells at apex and border; 11, peristome teeth and spores; 13, calyptra; 15, operculum.

PLATE XI.

PLATE XII.

PLATE 12. *A. Fissidens Hallii.* 1, plant × 1, 4; 2, plant × 10; 3, leaves × 20; 4, perichaetial leaves × 20; 5, leaf base × 200; 6, leaf base × 100; 7, cells of upper leaf margin × 200; 8, capsules × 13; 9, exothecial cells × 200; 10, peristome teeth × 100; 10, a single tooth × 200.

B. Fissidens subcrenatus. 1, plant × 1.3; 2, plant × 10; 3, leaves × 20; 4, perichaetial leaves × 20; 5, leaf base × 100; 6, leaf apex × 200; 7, capsule × 20.

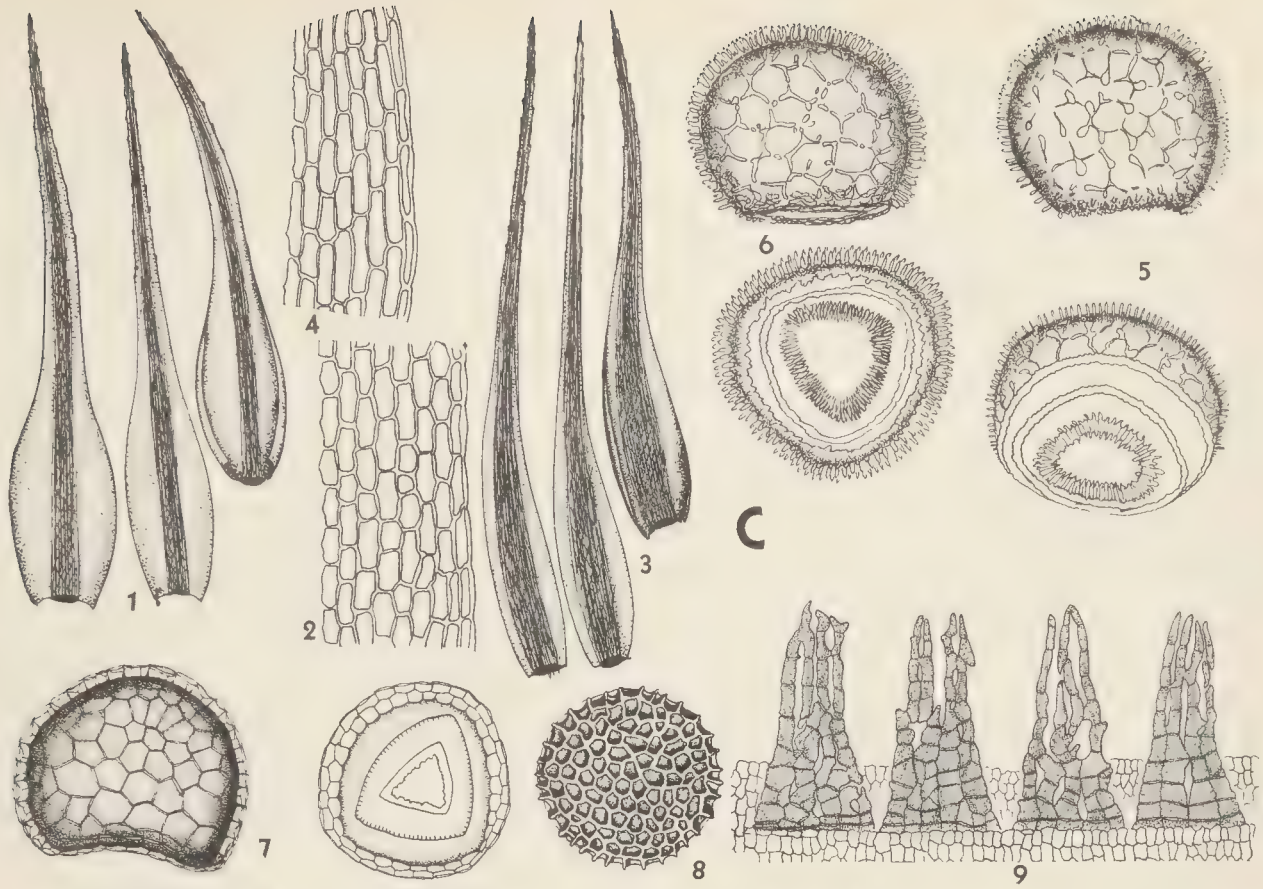
C. Fissidens Bushii. 1, plant × 1; 2, plant × 5; 4, leaves × 10; 3, perichaetial leaves × 10; 5, leaf base × 200; 6, leaf apex × 200; 7, operculate capsule × 20; 8, deoperculate capsule × 20; 10, peristome.

D. Fissidens manateensis. 1, peristome × 50; 2, portions of teeth × 200 and 400. (All drawings by Seville Flowers.)

PLATE 13. *A. Fissidens sublimbatus.* 1, plant × 3; 2, stem leaves × 20; 3, lower stem leaf × 20; 4, perichaetial leaves; 5, border of vaginant lamina × 200; 6, leaf apex × 200.

B. Fissidens Orcutti. 1, plants × 3; 2, male plants × 3; 3, antheridia and perigonial leaves × 20; 4, stem leaves, upper and lower, × 20; 5, perichaetial leaves × 20; 6, 7, 8, basal, median and apical leaf cells respectively × 200; 9, capsule × 13.

C. 1, leaves of *Pleuridium subulatum* × 20; 2, upper median leaf cells of same × 200; 3, leaves of *P. acuminatum* × 20; 4, upper median leaf cells of same × 200; 5, spores of *Bruchia texana* × 400; 6, spores of *Bruchia Donnellii* × 400; 7, spores of *Bruchia Drummondii* × 400; 8, spore of *Bruchia Carolinae* × 400; 9; peristome of *Distichium Hageni* × 100. (All drawings by Seville Flowers.)



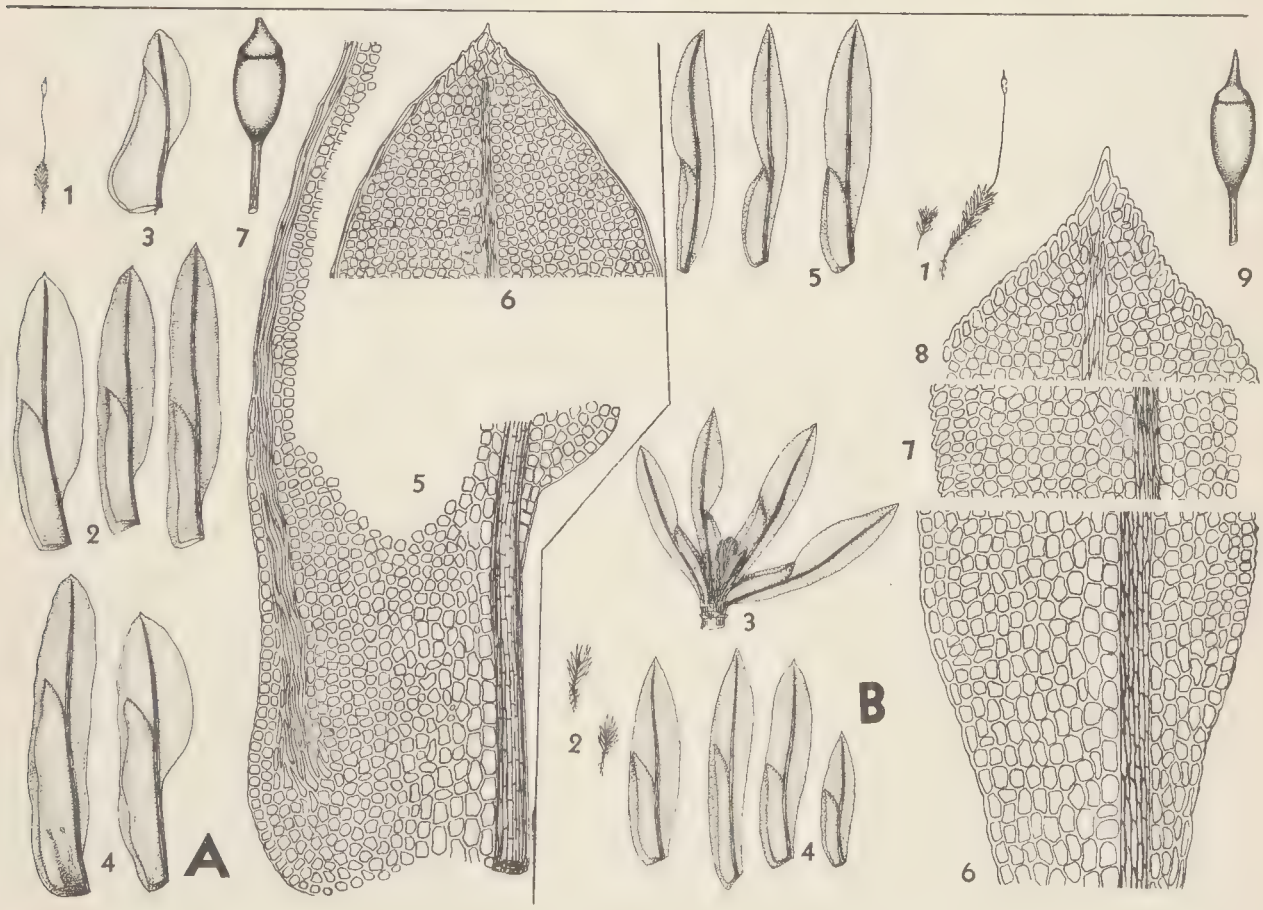


PLATE XIII.

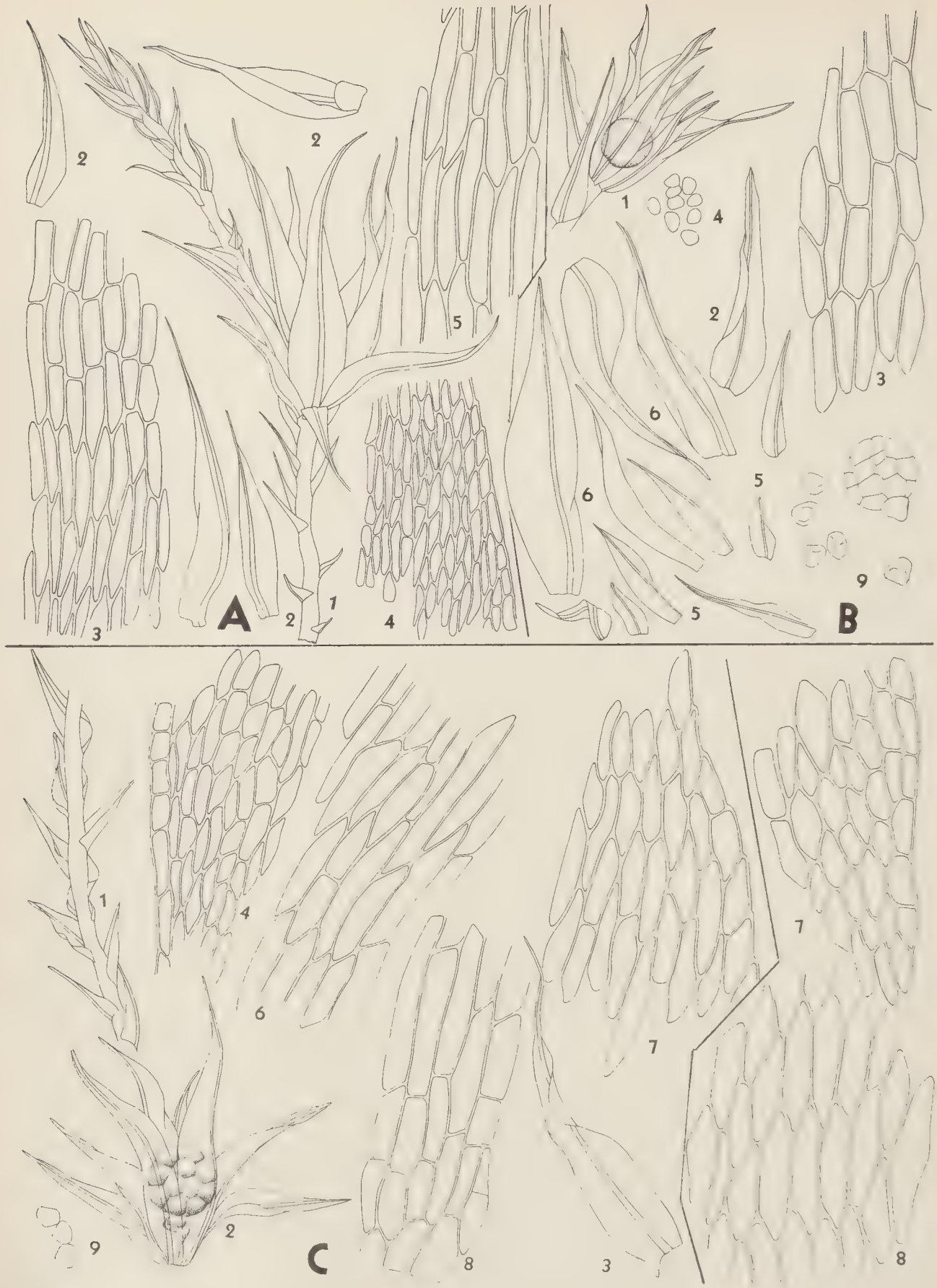


PLATE XIV.

PLATE 14. *A. Archidium Donnellii.* 1, plant × 22; 2, perichaetial leaves × 22; 3, basal cells of perichaetial leaf; 5, median cells of perichaetial leaf; 4, upper cells of stem leaf; all cells × 220.

B. 1, *Archidium Hallii* var. *minus* × 22; 2, leaf of same × 22; 3, lower median cells of perichaetial leaf of 1 × 220; 4, spores of 1 × 22; 5, stem leaves of *A. Hallii* × 22; 6, perichaetial leaves of same × 22; 7, median cells of perichaetial leaf near margin × 220; 8, same in interior × 220; 9, capsule and spores × 22.

C. Archidium alternifolium. 1, portion of stem with leaves × 22; 2, perichaetial leaves and capsule × 22; 3, perichaetial leaf × 22; 4, middle marginal cells of stem leaf × 220; 6, median cells of perichaetial leaf × 220; 7, middle marginal cells of same; 8, basal cells of same; 9, spores × 22. (Drawings by Stanley Cain.)

PLATE 15. *A. Archidium floridanum.* 1, perichaetial leaves and capsule × 22; 2, 3, stem leaves × 22; 4, antheridial bud × 53; 5, perichaetial leaves × 22; 6, median marginal cells of stem leaf × 220; 7, basal marginal cells of same × 220 (all from the type).

B. Archidium longifolium. 1, plant × 22; 2, perichaetial leaves × 22; 3, basal marginal cells of perichaetial leaf × 220; 4, median marginal cells × 220. (*A* & *B* drawn by Stanley Cain).

C. Archidium ohioense (from Sull. Icones Musc. *pl. 7*). 1, plants × 1; 2, plants with capsules; 6, leaf showing areolation; 7, capsule with perichaetial leaves; 10, perichaetial leaves; 12, capsule with calyptra; 13, section of capsule with spores; 14, 15, spores; 16, 17, antheridial buds.

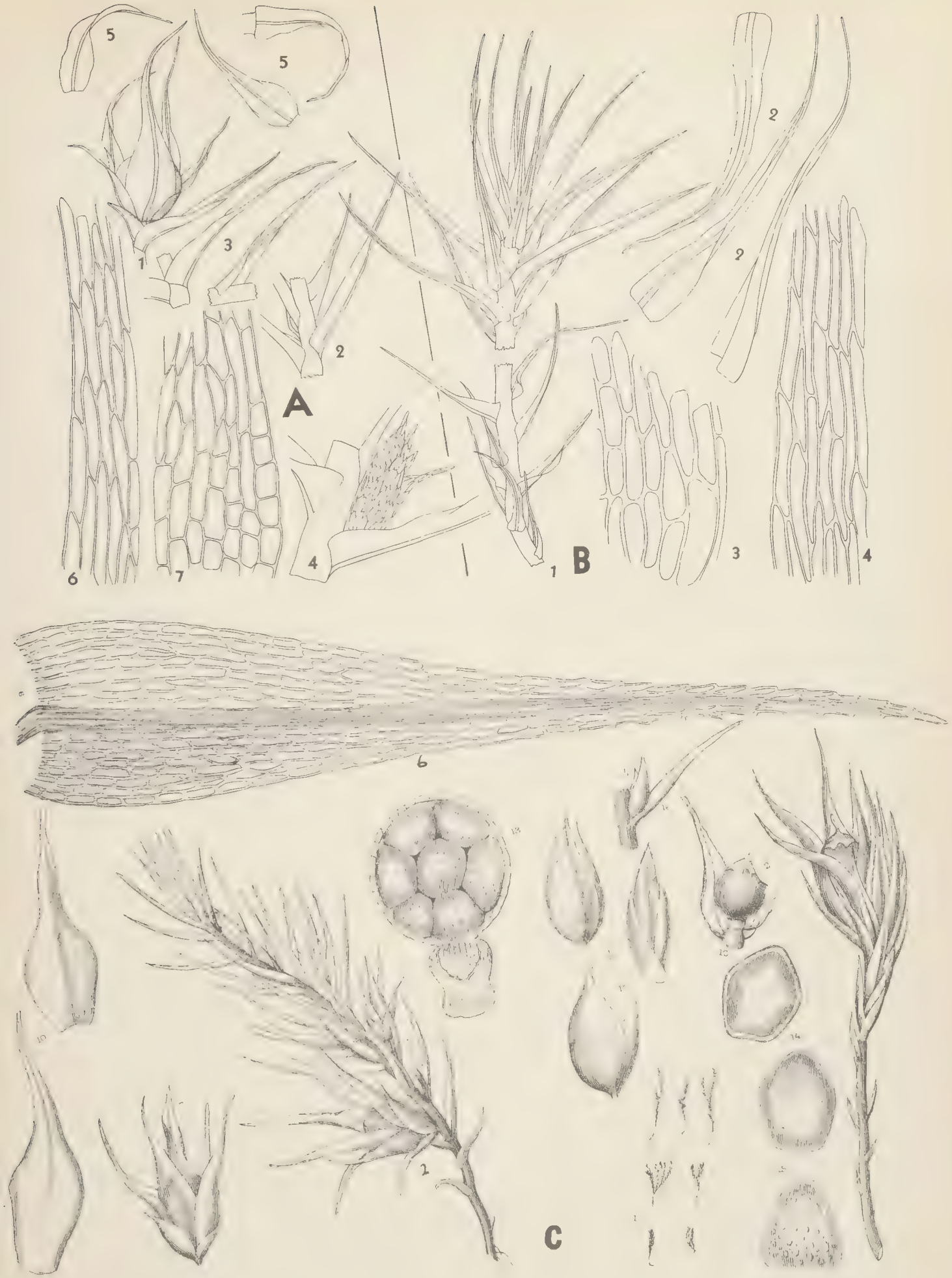


PLATE XV.

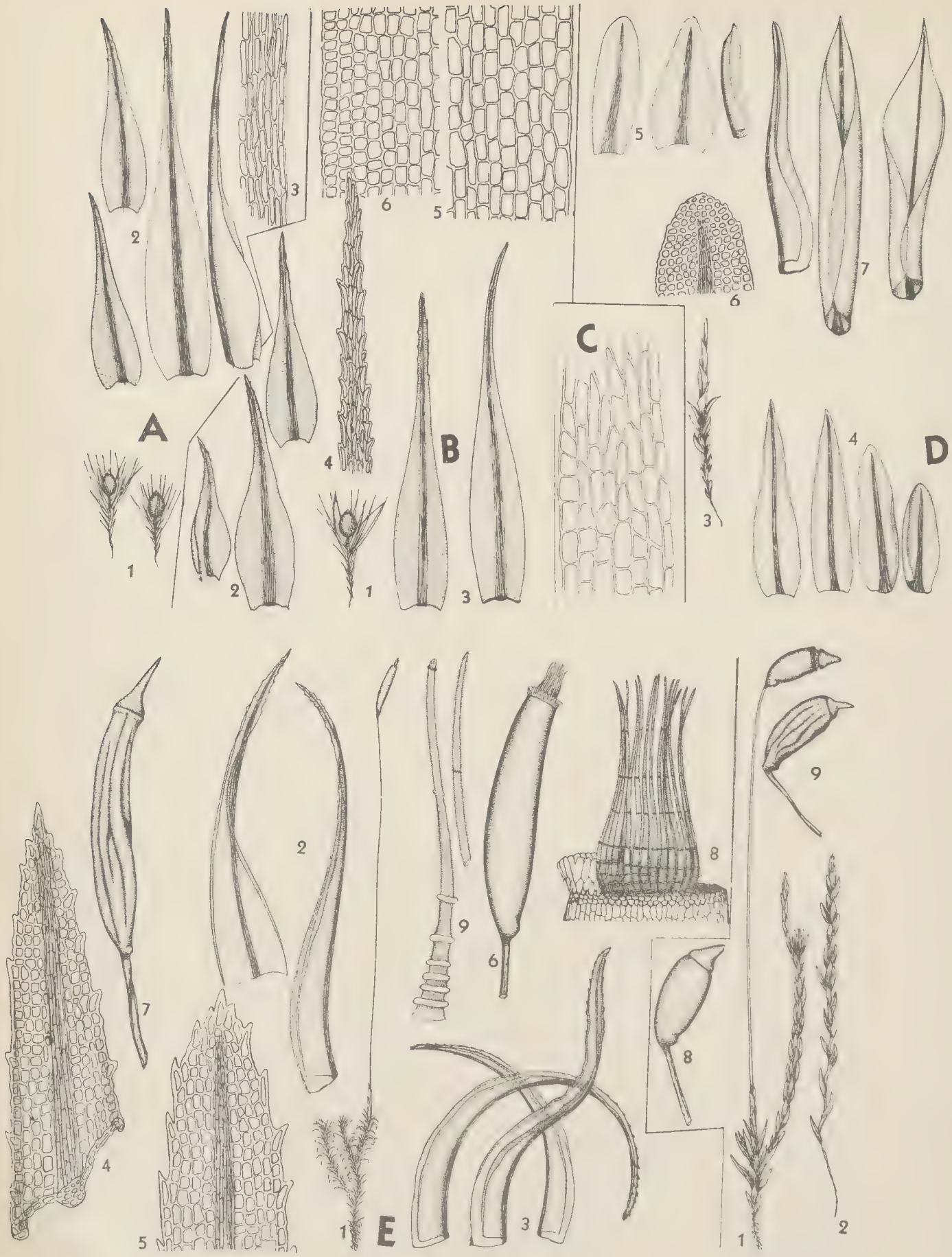


PLATE XVI.

PLATE 16. *A. Pleuridium Ravenelii.* 1, plant × 3; 2, leaves × 20; 3, upper basal leaf cells × 200.

B. Pleuridium californicum. 1, plant × 3; 2, leaves × 20; 3, perichaetial leaves × 20; 4, leaf apex × 200; 5, upper basal leaf cells × 200; 6, upper basal cells of lower leaf × 200.

C. Marginal basal cells of *Archidium ohioense.*

D. Ceratodon heterophyllus. 1, plant with innovation × 7; 2, sterile shoot × 7; 3, fertile stem with young sporophyte; 4, stem leaves × 20; 5, leaves of sterile shoots × 20; 6, apex of upper leaf × 200; 7, comal and perichaetial leaves × 20; 8, 9, capsules moist and dry.

E. Ceratodon stenocarpus. 1, plant × 3; 2, leaves of Mexican plant × 20; 3, leaves of Arizona plant × 20; 4, apex of leaf of Mexican plant × 200; 5, apex of leaf of Arizona plant × 200; 6, moist capsule × 13; 7, same dry; 8, peristome × 100; 9, one prong of peristome tooth × 400. (Drawings, except *C*, by Seville Flowers.)

PLATE 17. *A*. *Pleuridium Sullivanti* (from Sull. Icones. Musc. *pl. 10*). 2, plant much magnified; 4, 5, 6, leaves, stem and perichaetial; 8, 9, 10, leaf cells at base and apex; 11, cross section of leaf.

B. *Pleuridium Bolanderi* (from Bot. Gaz. **37**: *pl. 16*). *2a*, plant × 17; *2b*, leaves × 26; *2b'*, perichaetial leaf × 26; *2c*, leaf apex × 90, and median cells × 270; *2d*, basal leaf cells × 200; *2f*, *2g*, capsules × 26; *2h*, calyptra × 26.

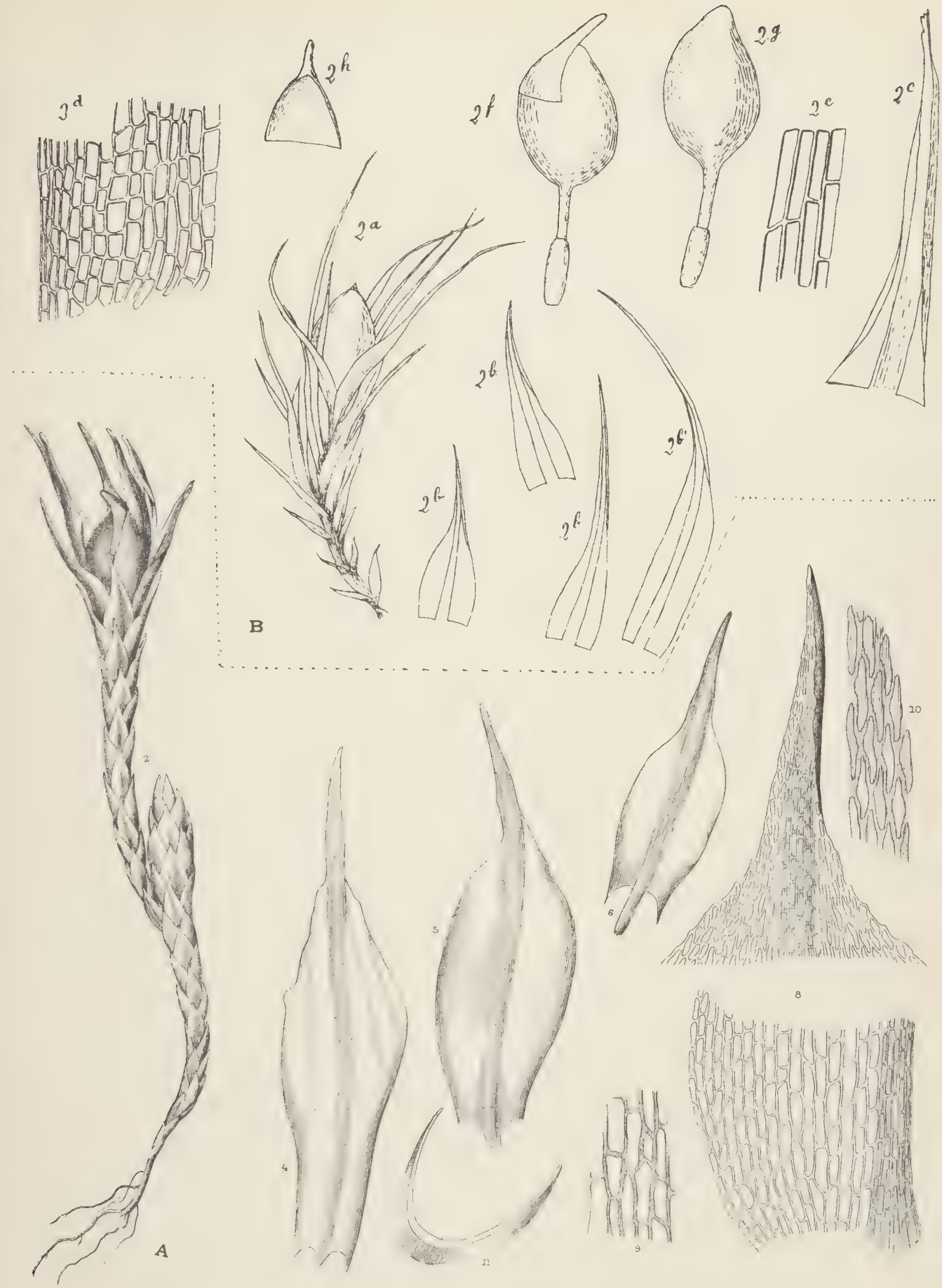
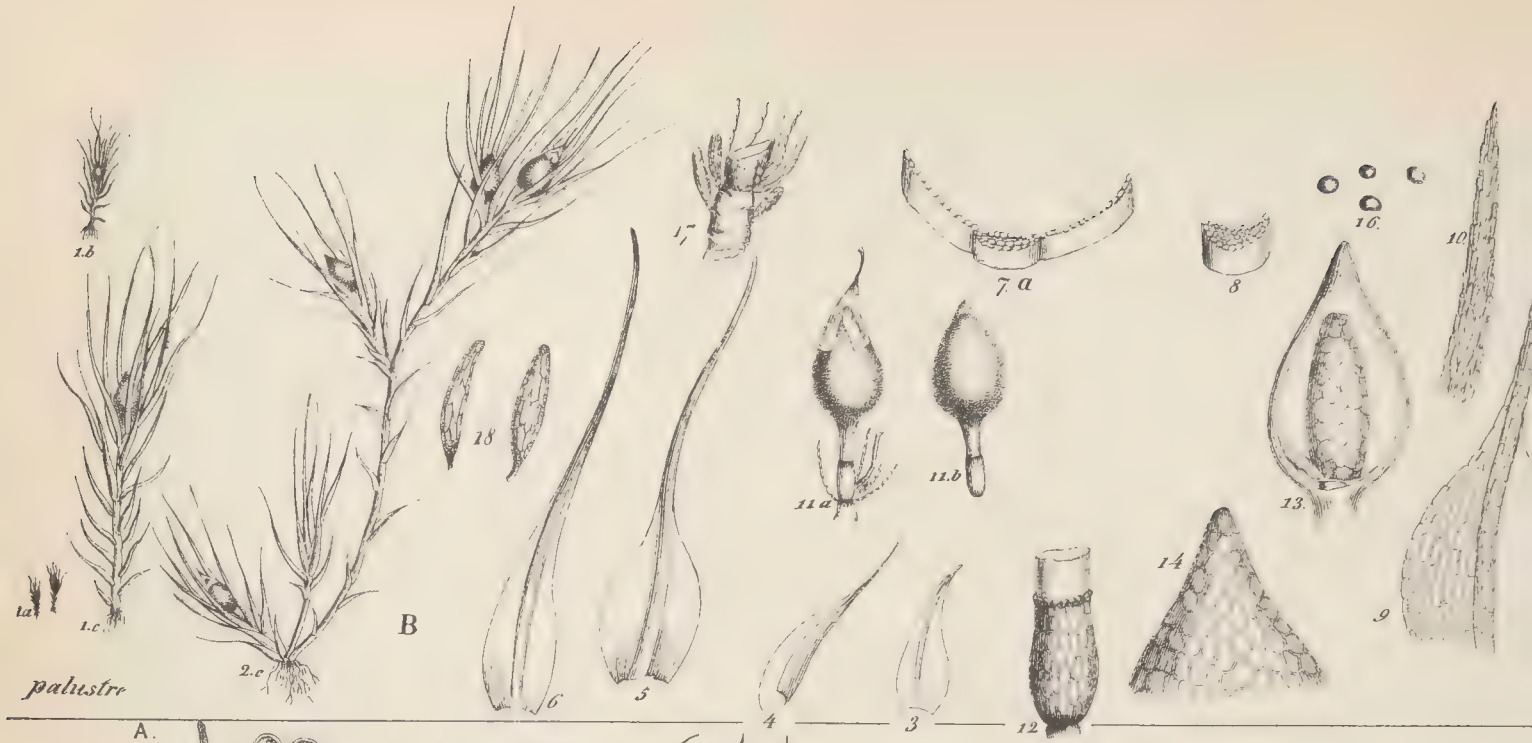
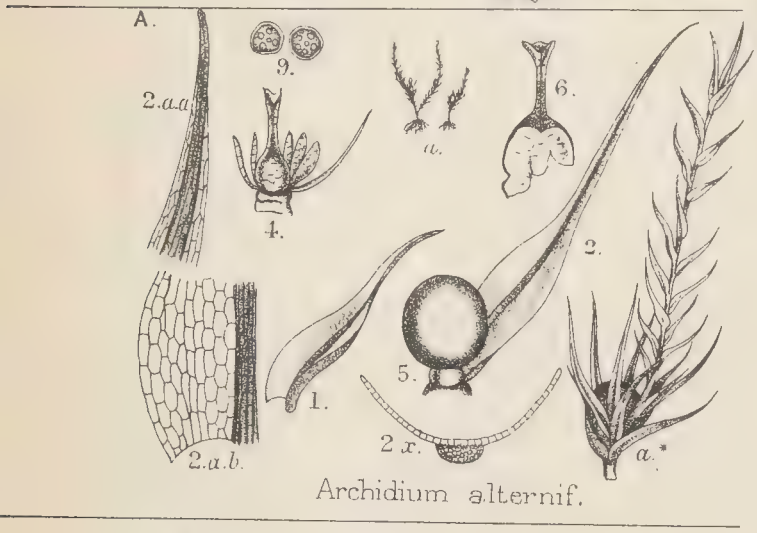
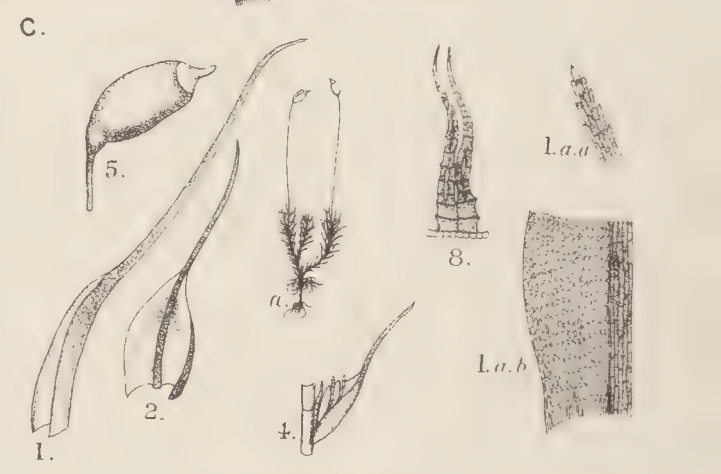
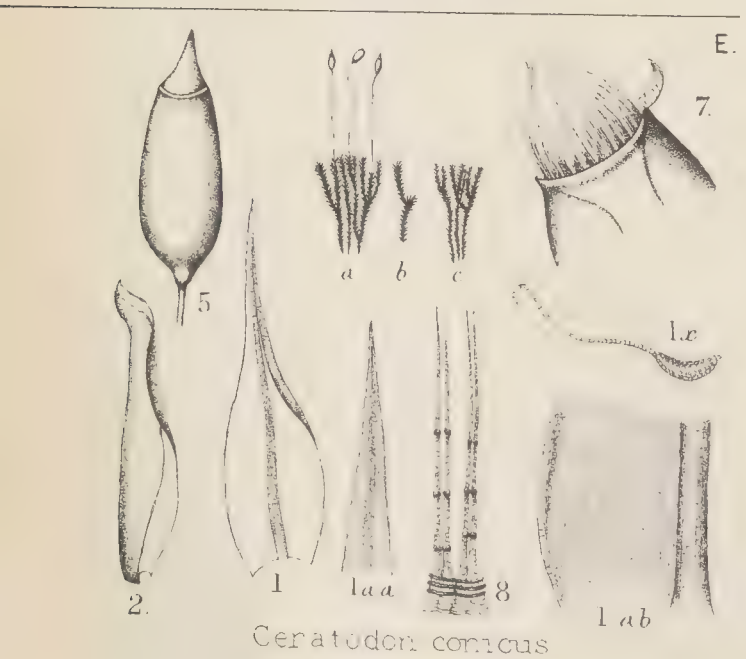


PLATE XVII.


palustre
B


A.
Archidium alternif.


C.
Swartzia inclinata.


E.
Ceratodon conicus

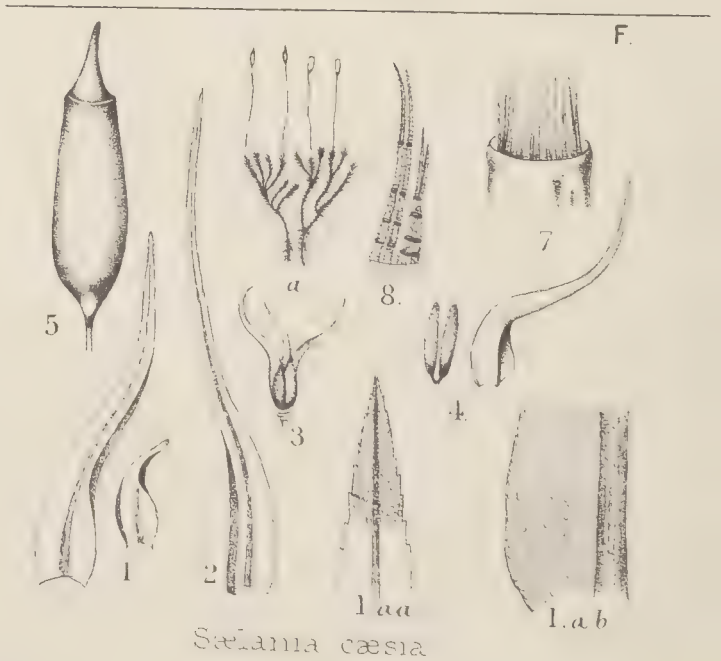

F.
Sælania cæsia

PLATE XVIII.

PLATE 18. *A. Archidium alternifolium; C. Distichium* (*Swartzia*) *inclinatum; E. Ceratodon conicus; F. Saelania glaucescens* (*caesia*). (*A, C, E, F*, from Braithw. Brit. Moss Fl. 1: plates 14, 15, and 26). *a, b, c*, plants × 1; *a**, same magnified; 1, leaf; 1*a*, apical leaf cells; 1*b*, basal leaf cells; 1*x*, cross section of 1; 2, perichaetial leaf; 2*aa* and 2*ab*, apical and basal cells of 2; 3, 4, antheridial bud and archegonia; 5, capsule; 6, calyptra; 7, 8, peristome.

B. Pleuridium palustre. (From Bry. Eur.). 1*a*, 1*b*, plants × 1; 1*c*, 2*c*, plants enlarged; 3, 4, 5, 6, leaves; 7*a*, 8, cross sections of leaf; 9, leaf cells; 10, leaf apex, 11*a*, 11*b*, capsules; 12, vaginula; 13, 14, capsule structure.

PLATE 19. *A. Bruchia flexuosa* (from Sull. Icones Musc. Suppl. *pl. 15*). 2, plant enlarged; 4, stem leaves; 5, leaf showing cells; 6, perichaetial leaf; 8, longitudinal section of capsule; 9, calyptrae.

B. Bruchia Sullivantii (from Sull. Icones Musc. *pl. 13*). 3, 4, plants enlarged; 5, 6, leaves; 7, 8, cells of leaf base and apex respectively; 9, cross section of leaf; 11, calyptra; 12, spores.

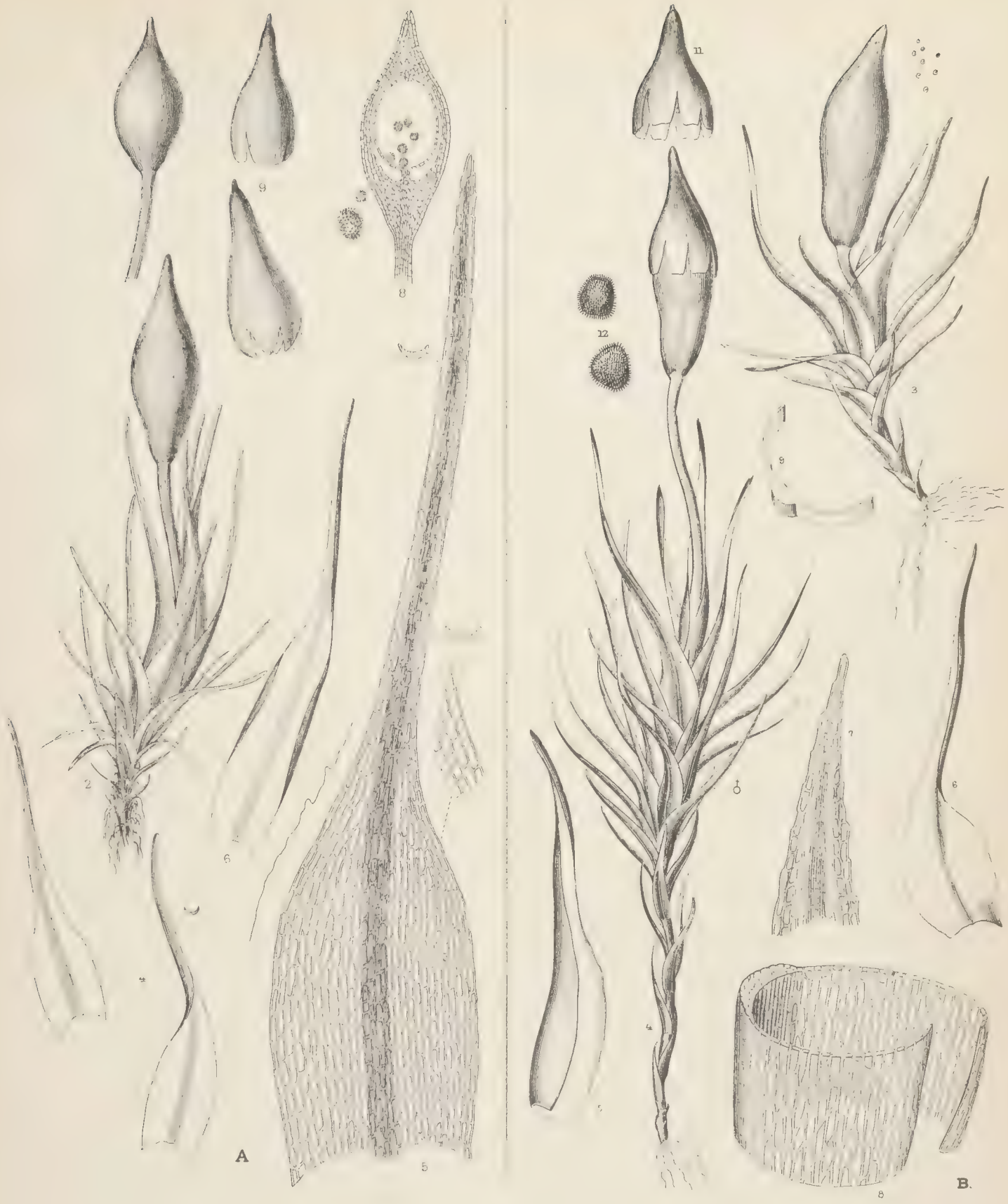
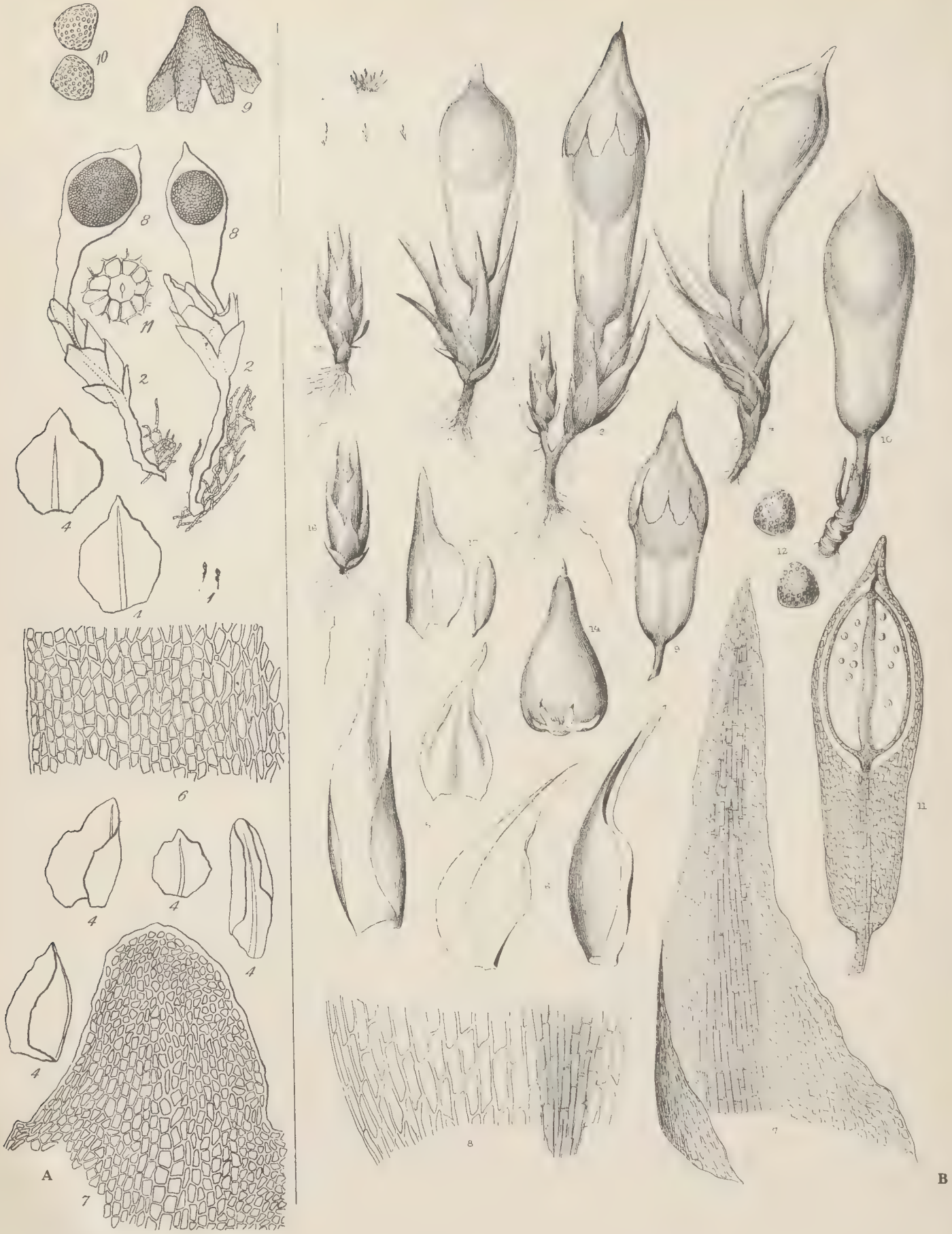


PLATE XIX.



BRUCHIA BREVIFOLIA, Sulliv

PLATE XX.

PLATE 20. *A*. *Bruchia fusca* (from Bull. Torr. Club **21**: *pl. 216*). 1, plants × 1; 2, enlarged; 4, leaves; 6, median leaf cells; 7, leaf apex showing cells and vanishing costa; 9, calyptra; 10, spores; 11, stoma.

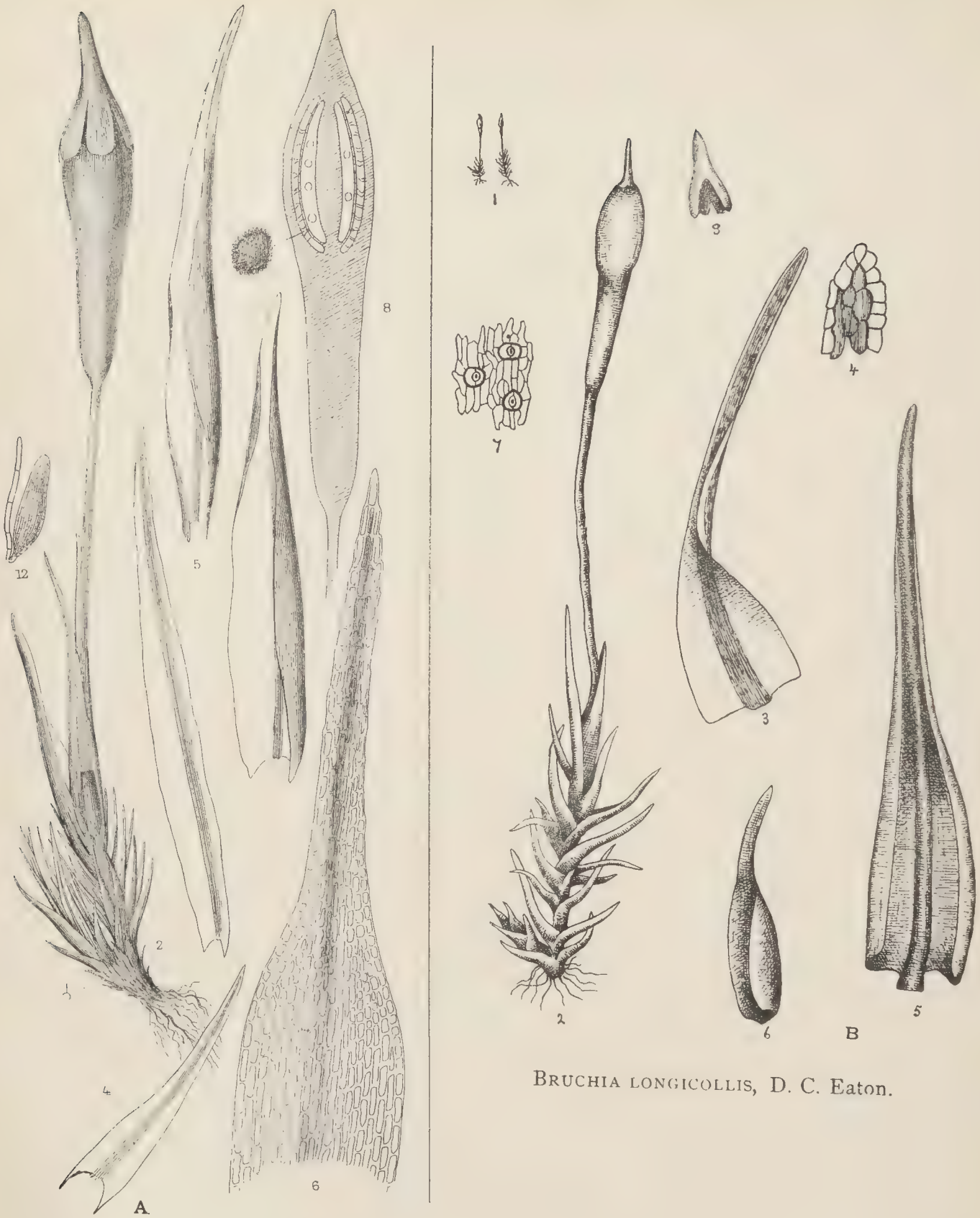
B. *Bruchia brevifolia* (from Sull. Icones Musc. *pl. 15*). 1, plants × 1; 2, 3, 4, plants enlarged; 5, 6, leaves; 7, 8, cells at apex and base of leaf respectively; 9, 10, capsules; 11, longitudinal section of capsule; 12, spores; 13, calyptra; 15, 16, 17, male inflorescence and antheridia.

PLATE 21. *A. Bruchia Ravenelii* (from Sull. Icones Musc. *pl. 16*). 1, 2, plants × 1; 3, 4, 5, 6, plants enlarged; 7, capsule with perichaetial leaf; 8, upper stem leaves; 9, perichaetial leaves; 10, 11, cells of leaf base and apex respectively; 12, 13, calyptrae; 15, antheridial bud; 16, 17, perigonial leaves and antheridium.

B. Bruchia Carolinae (from Bull. Torr. Club **21**: *pl. 217*). 2, 3, plants enlarged; 6, spores; 7, exothecial cells and stomata; 8, leaves.

BRUCHIA RAVENELII, Wils.

PLATE XXI.



BRUCHIA LONGICOLLIS, D. C. Eaton.

PLATE XXII.

PLATE 22. *A*. *Bruchia Bolanderi* (from Sull. Icones Musc. Suppl. *pl. 14*). 2, plant enlarged; 4, 5, leaves; 6, leaf showing cells; 8, longitudinal section of capsule; 12, antheridium.

B. *Bruchia longicollis* (from Bull. Torr. Club **17**: *pl. 101*). 1, plants × 1; 2, plant enlarged; 3, leaf; 4, apex of 3; 5, perichaetial leaf; 6, perigonial leaf; 7, stomata of neck; 8, calyptra.

PLATE 23. *A*. *Bruchia texana* (from Bull. Torr. Club **21**: *pl. 213*). 1, plants × 1; 2, plant enlarged; 3, leaves; 4, 5, cells of leaf base and apex respectively; 7, dry capsule; 8, calyptra.

B. *Bruchia Donnellii* (from Bull. Torr. Club **21**: *pl. 214*). 1, plants × 1; 2, 3, plants enlarged; 6, calyptra; 8, leaves; 9, 10, cells of leaf base and apex respectively.

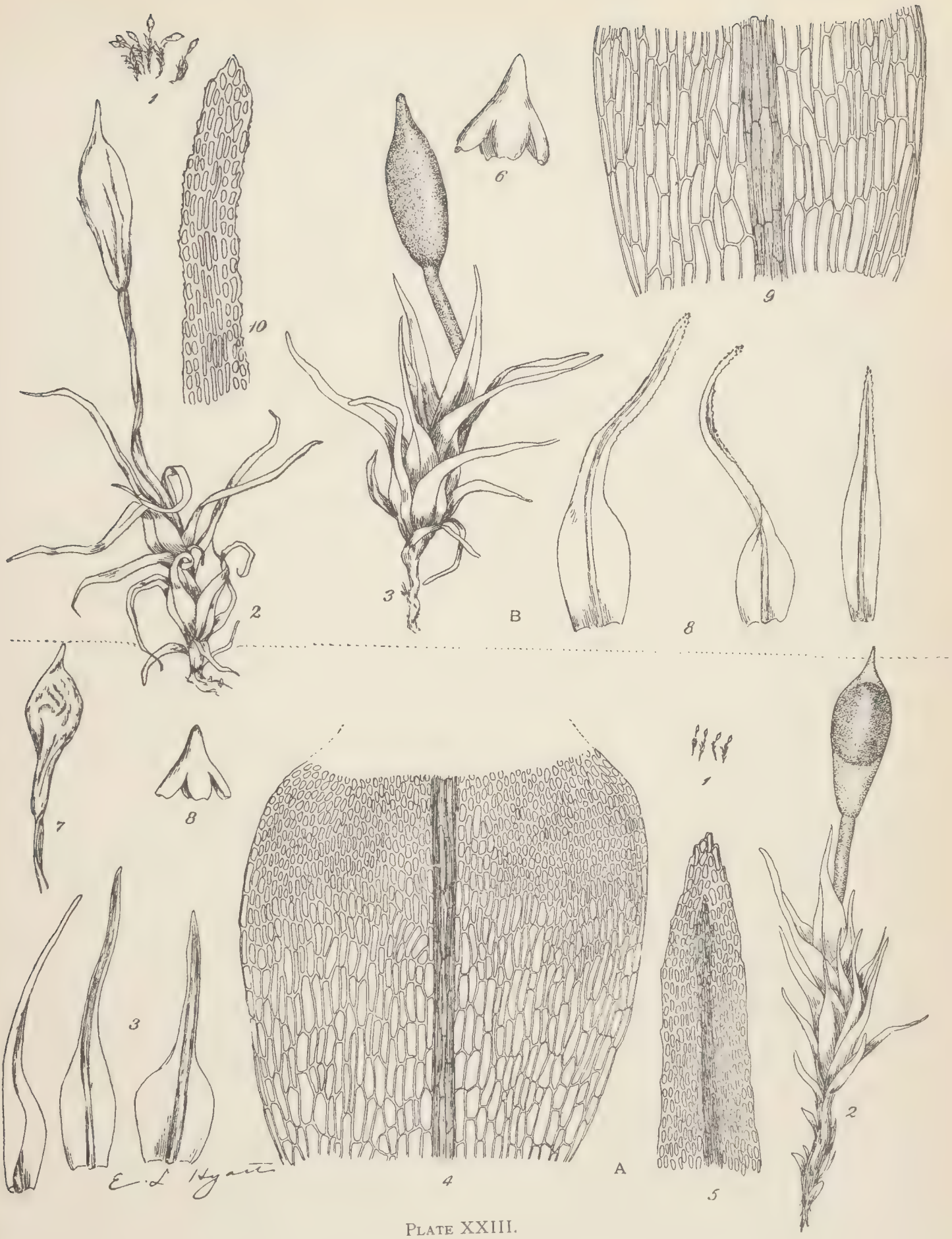
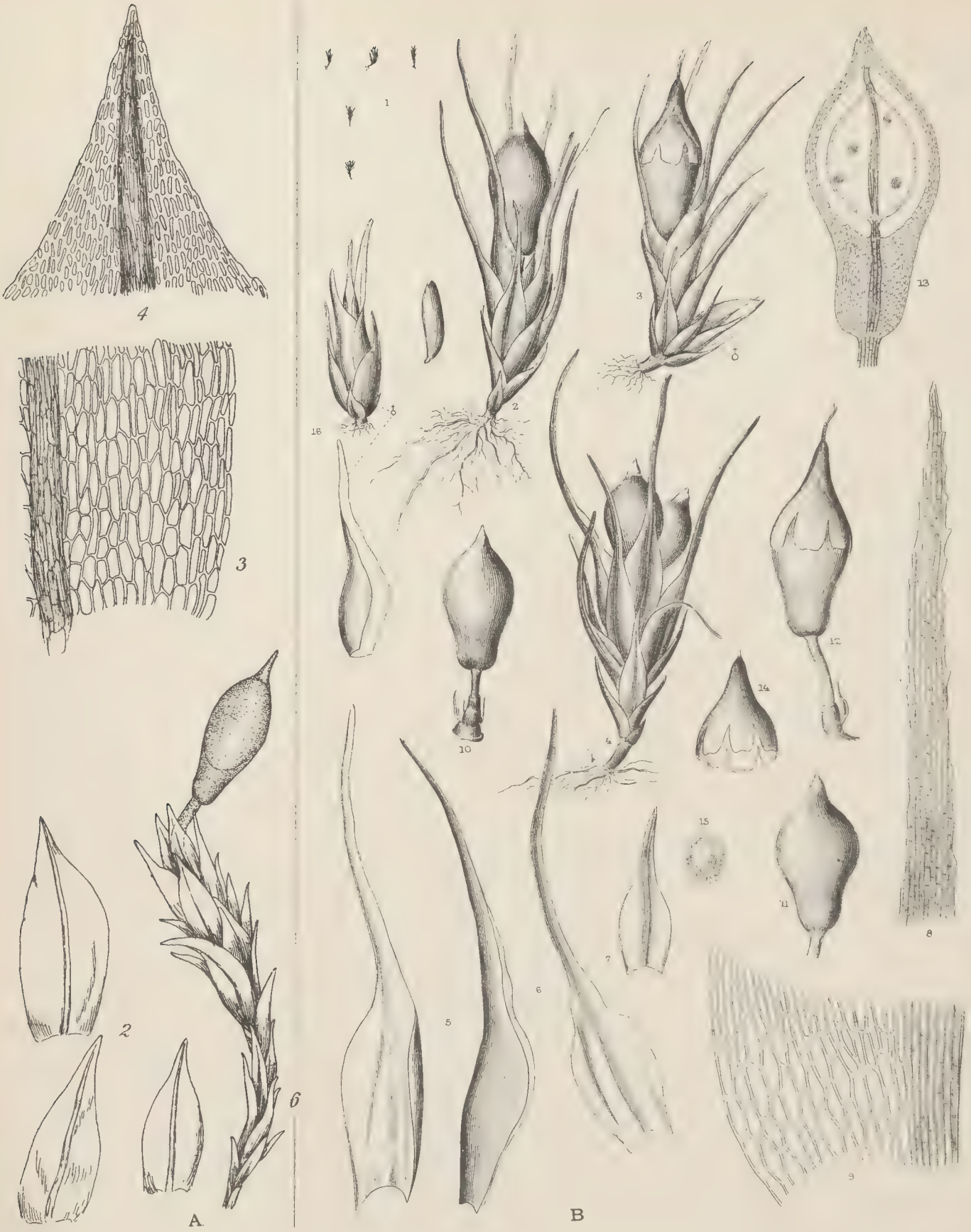


PLATE XXIII.



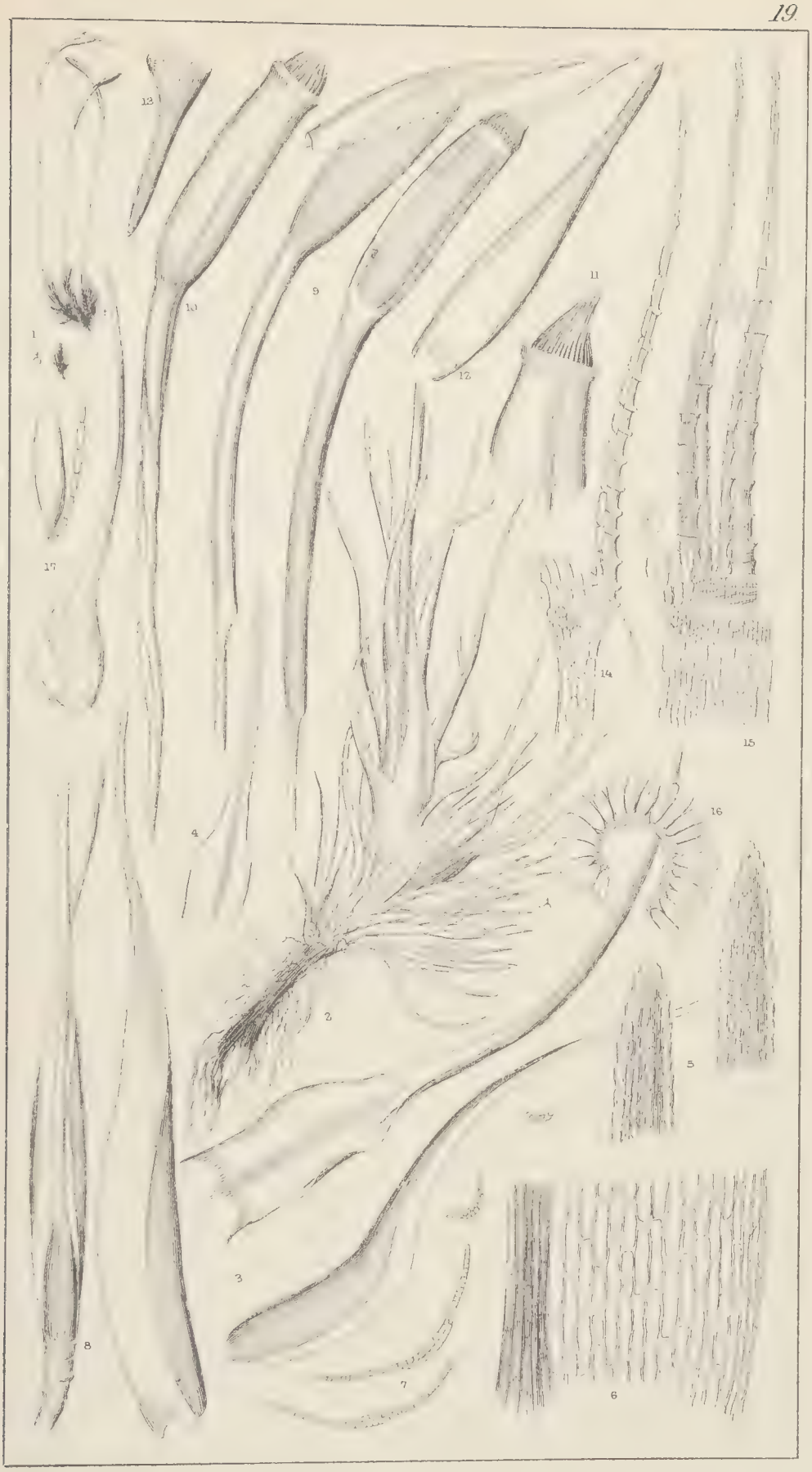
BRUCHIA BREVIPES, Hook.

PLATE XXIV.

PLATE 24. *A. Bruchia Hallii* (from Bull. Torr. Club. **21**: *pl. 215*). 2, leaves; 3, 4, cells of leaf base and apex respectively; 6, plant much enlarged.

B. Bruchia Drummondii (from Sull. Icones Musc. *pl. 14*) (as *B. brevipes*). 1, plants × 1; 2, 3, 4, plants magnified; 5, 6, 7, leaves; 8, 9, cells of leaf apex and base respectively; 10, 11, 12, capsules; 13, longitudinal section of capsule; 14, calyptra; 16, antheridial bud with leaf and antheridium. (15 does not accurately represent the spore, see *pl. 21*).

PLATE 25. *Trematodon longicollis.* (Sull. Icones Musc. *pl. 19*). 1, plants × 1; 2, part of a plant enlarged; 3, 4, stem leaves; 5, leaf apices showing cell structure; 6, leaf cells at base; 7, cross sections of leaf; 8, perichaetial leaf, vaginula and base of seta; 9, capsules; 10, dry capsule; 11, mouth of capsule with peristome; 12, calyptra; 13, operculum; 14, 15, peristome teeth and annulus; 16, annulus; 17, antheridia and perigonial leaf.



TREMATODON LONGICOLLIS, Michx.

PLATE XXV.

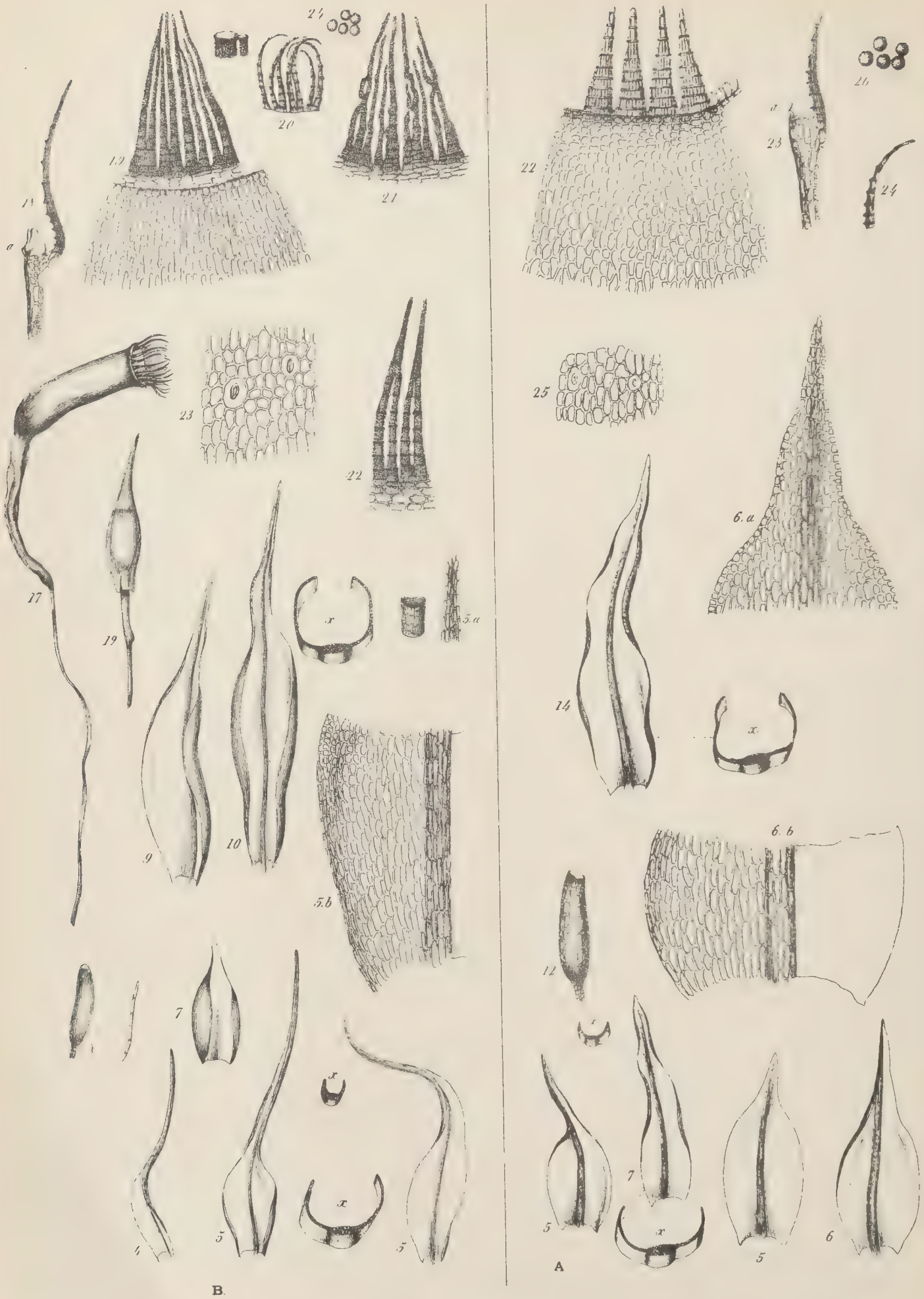


PLATE XXVI.

PLATE 26. *A*. *Trematodon brevicollis* (from Bry. Eur. *pl. 95*). 5–7, leaves; 6*a*, 6*b*, cells of leaf apex and base respectively; 14, perichaetial leaf; 12, antheridium; 22, mouth of capsule with four peristome teeth; 23, longitudinal section of same showing annulus; 24, side view of tooth; 25, exothecial cells and stomata; 26, spores.

B. *Trematodon ambiguus* (from Bry. Eur. *pl. 96*). 4, lower leaf; 5, upper leaves; 5*a*, 5*b*, leaf apex and base respectively showing cells; 7, perigonial leaf; 8, antheridium; 9, 10, perichaetial leaves; 12, very young capsule with calyptra; 17, dry and empty capsule; 18–22, peristome teeth; 23, exothecial cells and stomata; 24, spores.

PLATE 27. *A*. *Bryoxiphium norvegicum* (from The Plant World **1**: 2. 1897). 1, plants × 1 in normal habitat on stone; 2, three plants much enlarged, showing ♂ and ♀ plants and capsule; 3, two lower leaves; 4, two upper leaves; 5, 6, obtuse and acute leaf apices; 7, tapering serrate tip of leaf from apex of stem; 8, cells at base of leaf; 9, 10, cross sections of leaves; 11, mature capsule showing columella, attached operculum and calyptra; 12, operculum; 13, operculate capsule.

B. *Dicranella stikinensis* (drawings by Seville Flowers). 1, plants × 2; 2, portion of plant × 10; 3, upper and lower stem leaves × 20; 4, perichaetial leaves × 20; 5, apex of stem leaf × 20; 6, apex of inner perichaetial leaf × 20 (not all plants have leaves as blunt); 7, basal leaf cells × 200; 8, capsules × 13; 9, peristome teeth × 100, and portions of tooth × 400.

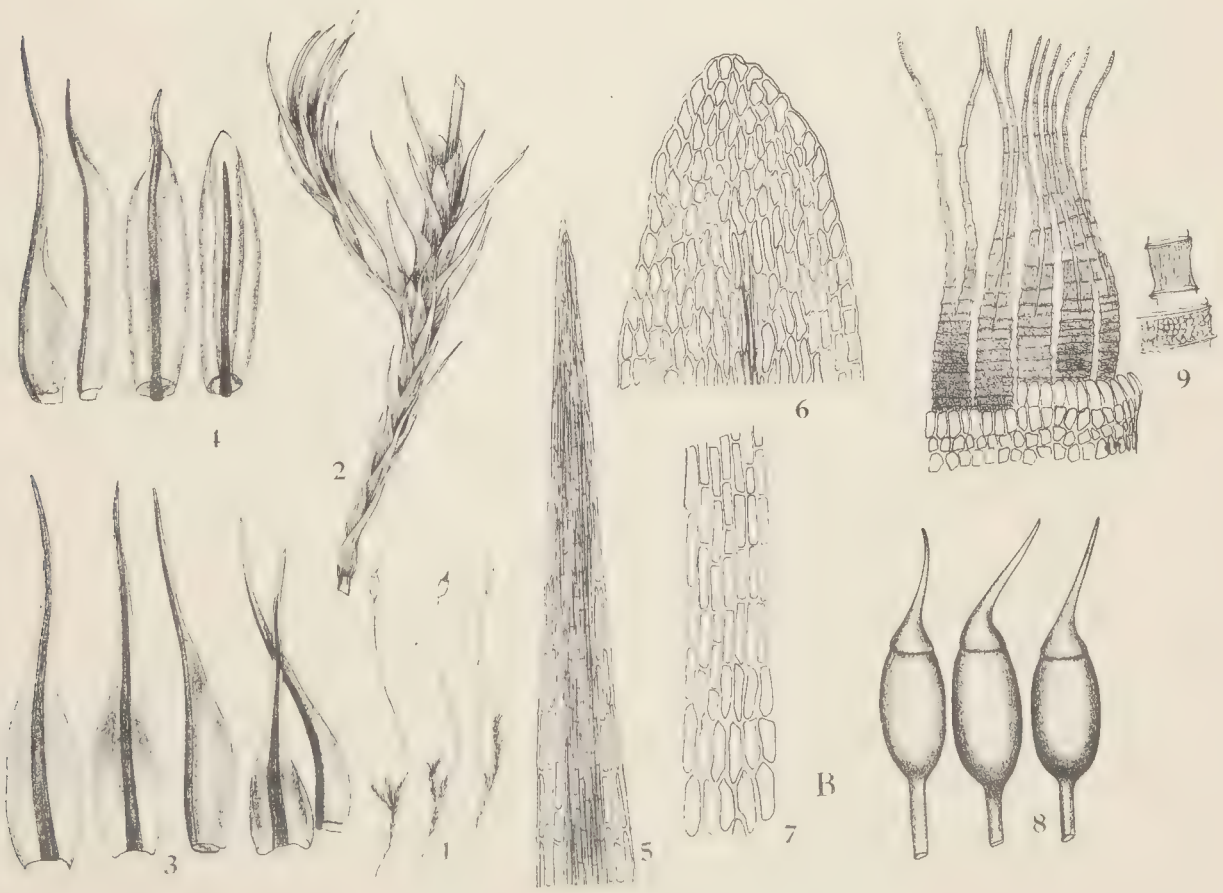


PLATE XXVII.

PLATE XXVIII.

PLATE 28. *A*. *Ditrichum lineare* (from Sull. Icones Musc. *pl. 28*). 3, plant with innovation, enlarged; 6, leaf; 8, lower leaf; 9, 10, areolation of leaf base and apex respectively; 12, comal and perichaetial leaves at base of seta; 13, perichaetial leaf; 15, peristome teeth and a portion of the annulus.

Ditrichum pallidum and *D. pusillum* (*tortile*) (from Jennings, Mosses W. Pennsylvania, *pl. 6*). *P*, plant; 1, leaf; 1*a*, leaf apex; 1*b*, cells at leaf base; 3, perichaetial leaf; 6, capsule; 7, calyptra; 8, peristome; *t*, portion of peristome tooth.

PLATE 29. *A. Ditrichum flexicaule* and varieties. 1, stem leaves of *D. flexicaule* × 2; 2, perichaetial leaves × 20; 3, stem leaves of var. *densum* × 20; 4, leaves of var. *brevifolium* × 20; 5, basal leaf cells of *D. flexicaule* × 200; 6, basal and median leaf cells of var. *brevifolium* × 200; 7, 8, basal and median leaf cells of var. *densum* × 200; 9, peristome tooth of *D. flexicaule* × 100 and a portion of the same × 400.

B. Ditrichum ambiguum. 1, plants × 3; 2, upper stem leaves and perichaetial leaf × 20; 3, lower leaves × 20; 4, capsules × 20; 4^1 (right), capsule of Holzinger's Musc. Acro. Bor. Am. × 20; 5, peristome teeth × 100; 6, portion of tooth × 400.

C. Ditrichum tortuloides. 7, plant × 3; 8, stem leaves × 20; 9, perichaetial leaves × 20. (Drawings by Seville Flowers.)

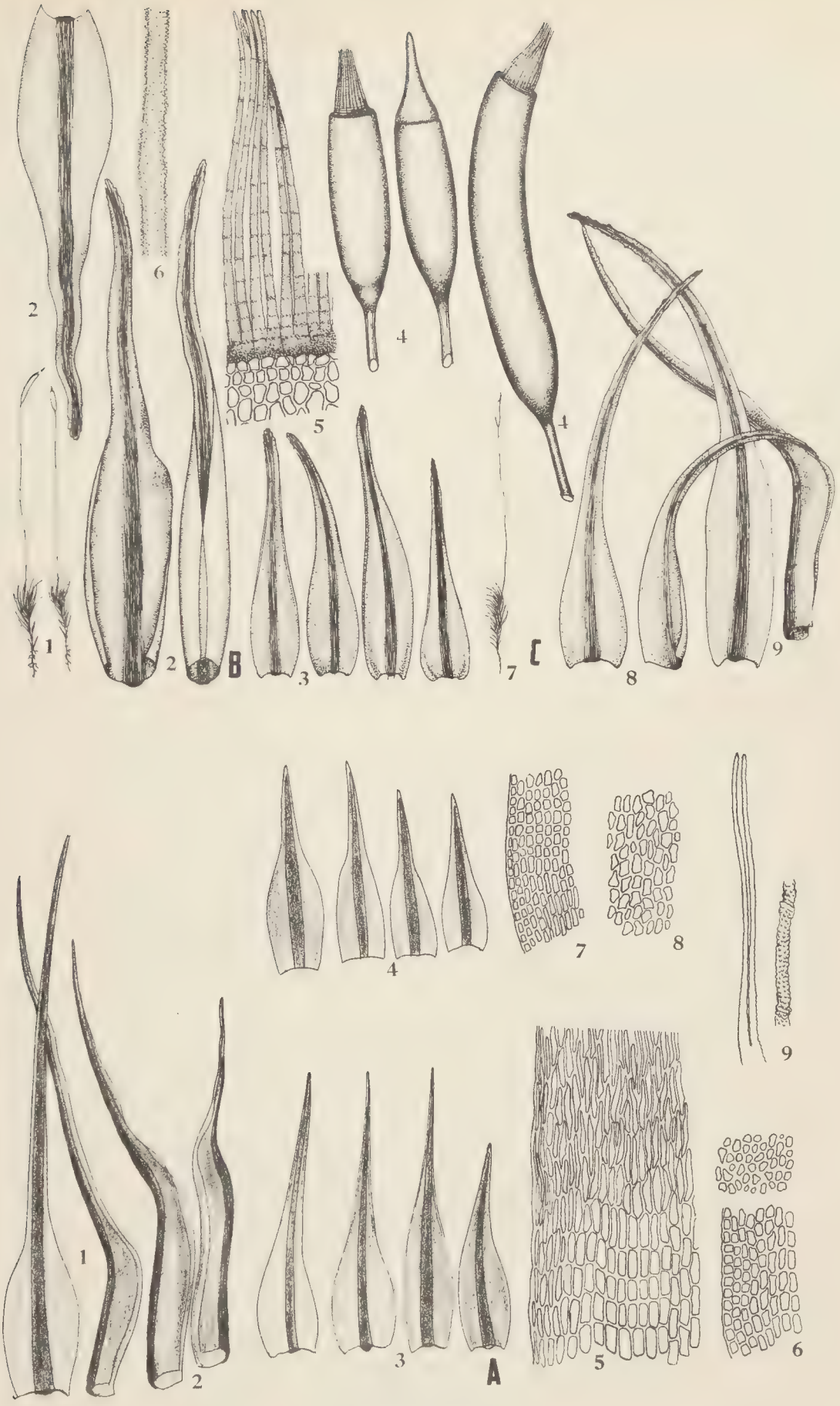


PLATE XXIX.

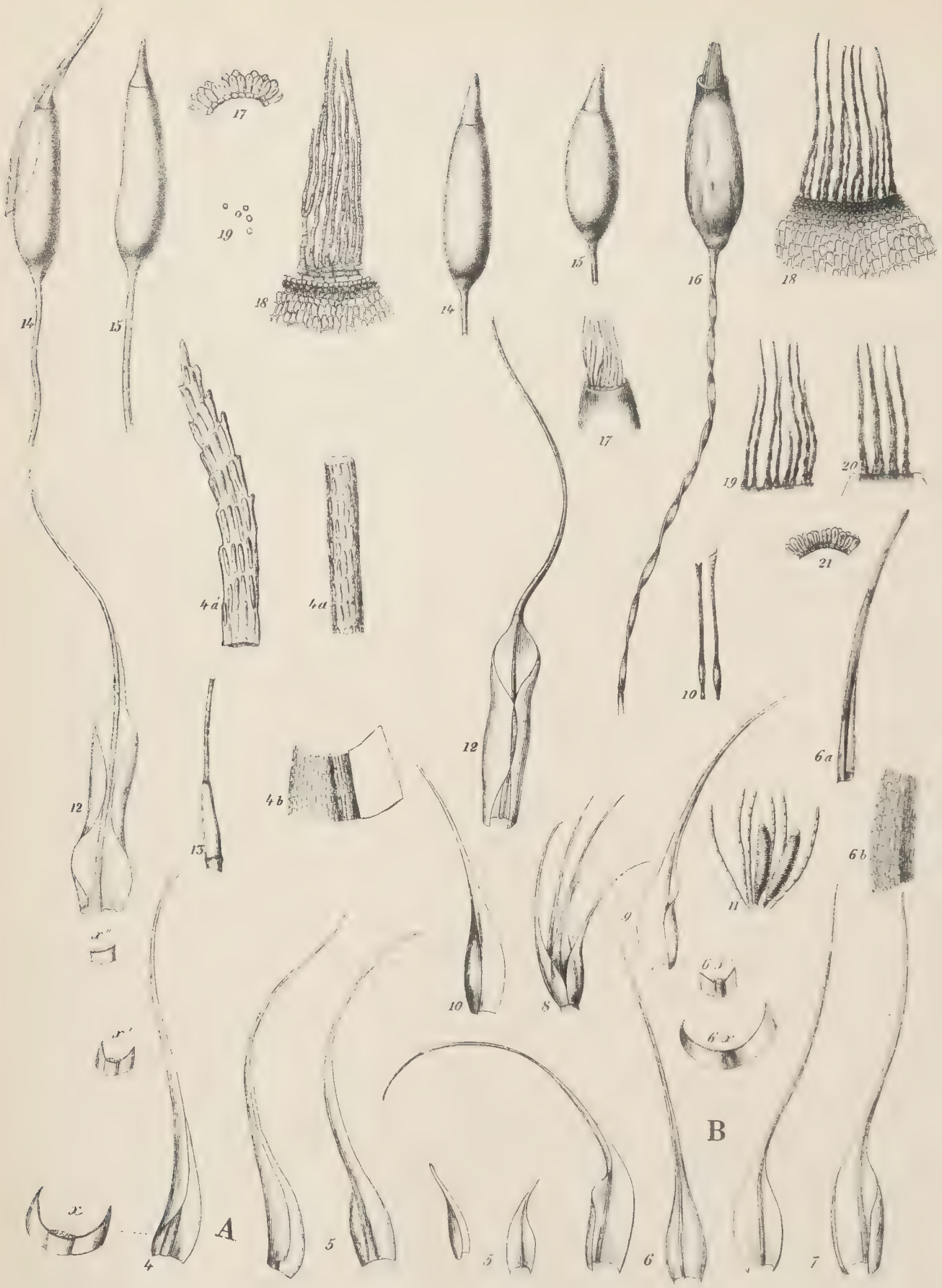

14
15
17
19
18
14
15
16
18
17
19
20
21
4a
4a
10
12
6a
4b
13
12
6b
11
9
10
8
6x
6x
x''
x'
x
A
B
4
5
5
6
7

PLATE XXX.

PLATE 30. *A. Ditrichum flexicaule* (from Bry. Eur. *pl. 180*). 4, 5, leaves; 4*b*, cells of upper basal part of leaf; 4*a*, leaf apex; 12, perichaetial leaf; 13, vaginula and base of seta; 14, 15, capsules, 14 with calyptra; 17, annulus; 18, portion of peristome; 19, spores.

B. Ditrichum heteromallum (*D. homomallum*) (from Bry. Eur. *pl. 181*). 5, 6, 7, stem leaves; 6*x*, 6*x*^{1}, cross sections of 6; 6*a*, leaf apex; 6*b*, cells at leaf base; 8, 9, 10, 11, perigonial leaves and antheridia; 10, also archegonia; 12, perichaetial leaf; 14, 15, 16, capsules; 17–20, peristome; 21, annulus.

PLATE 31. *Ditrichum giganteum* (from Bull. N. Y. Bot. Gard. **2**: *pl. 15*). 1, 2, plants × 1; 3, capsule × 5; 4, perichaetium × 9; 6, apex of stem leaf × 285; 7, exothecial cells and part of peristome × 285; 8, marginal cells ½ down leaf × 285; 9, upper stem leaf × 12; 10, basal leaf cells × 285; 11, part of annulus × 285.

Ditrichum montanum (from Bull. Torr. Club. **20**: *pl. 143*). 1, plant × 1; 2, capsule enlarged; 3, calpytra; 4*a*, cross sections of capsule, upper fresh; lower, old and dry; 5*a*, 5*b*, 5*c*, peristome teeth, basilar membrane and exothecial cells; 5*d*, exothecial cells near capsule base; 7, leaf apex flattened; 10*a*, cross section of apex; 7*a*, 7*b*, 7*c*, apical, median and basal leaf cells respectively; 10*b*, 10*c*, cross sections as indicated; 8, stem leaf; 9, two perigonial leaves and antheridia; 11, fragment of leaf near apex, showing double row of marginal cells; 12, male bud; 6, sheathing perichaetial leaf.

DITRICHUM GIGANTEUM

DITRICHUM MONTANUM, LEIBERG.

LEPTOTRICHUM SCHIMPERI.

PLATE XXXII.

PLATE 32. *Ditrichum Schimperi* (from Sull. Icones Musc. Suppl. *pl. 24*). 1, plants × 1; 2, plant enlarged; 3, stem and perichaetial leaves; 4, stem leaf; 5, sections of 4; 6, 7, cells of leaf apex and base; 8, part of stem with ♂ buds and base of seta; 9, capsules; 10, annulus and exothecial cells, peristome teeth and spores; 11, calyptra; 12–15, antheridial bud, perigonial leaves and antheridium with paraphysis.

PLATE 33. *A. Ditrichum cylindricum* (from Bry. Eur. *pl. 192*). 5–8, leaves; 7*a*, 7*b*, leaf apex and base; 9, 10, perigonial leaf and antheridium; 11, perichaetial and comal leaves; 12, 13, perichaetial leaves; 14, vaginula, base of seta and archegonium; 15, calyptra; 16–19, capsules; 20, operculum; 21, 23, 24, peristome; 22, annulus.

B. Ditrichum boreale (from Bryol. **14:** *pl. 2*). 1, operculate capsule; 2, peristome teeth; 3, marginal cells of operculum.

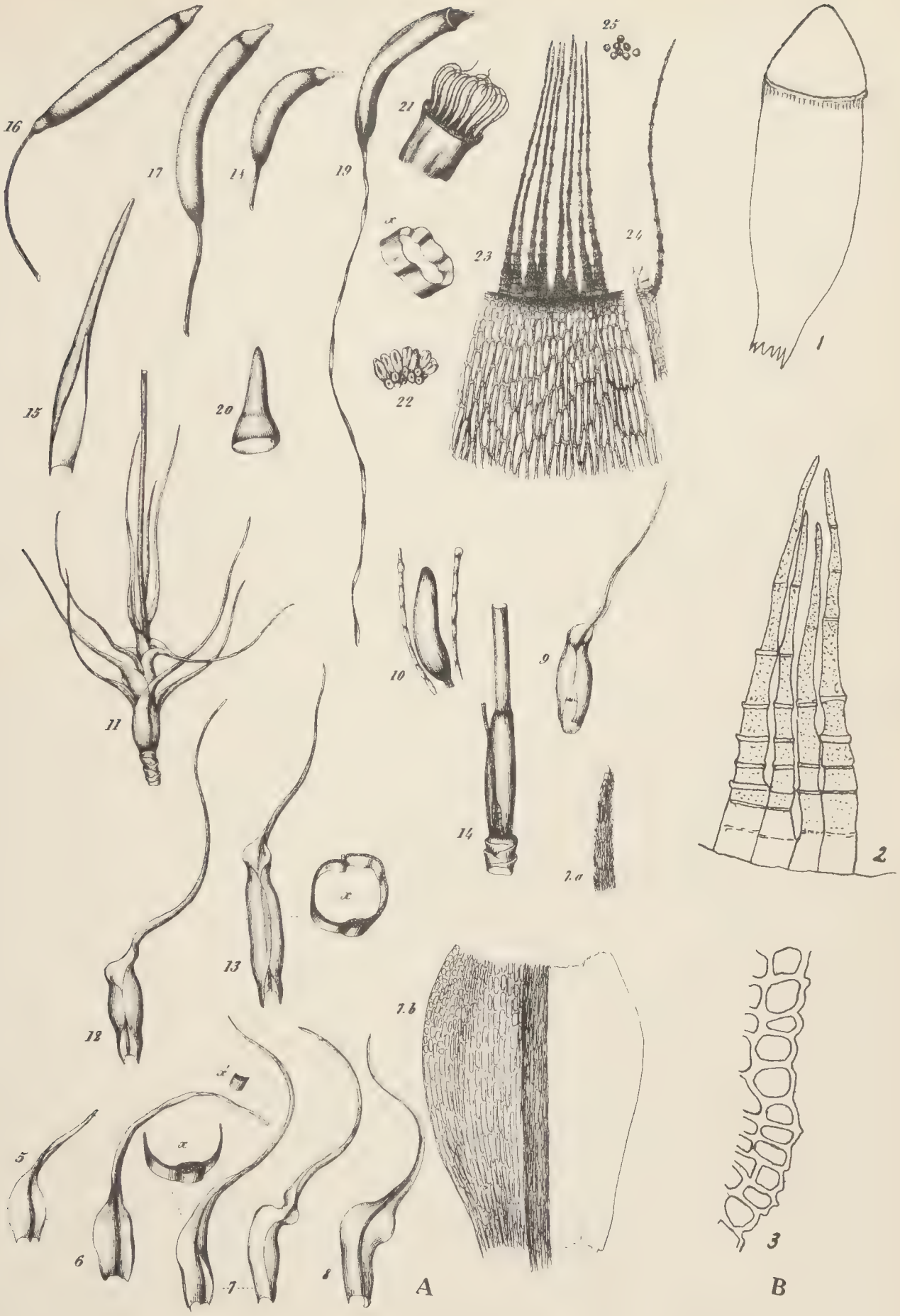
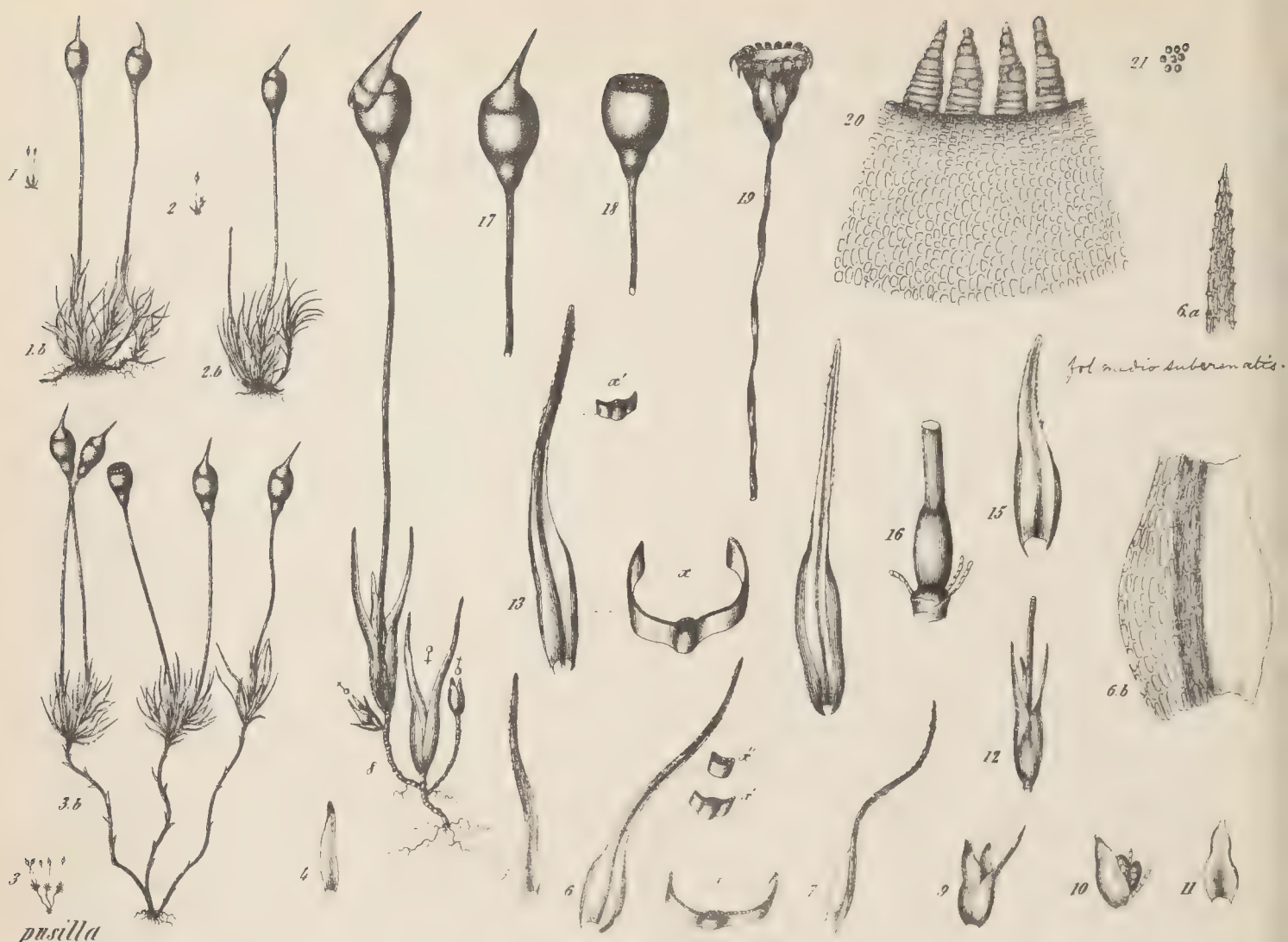


PLATE XXXIII.



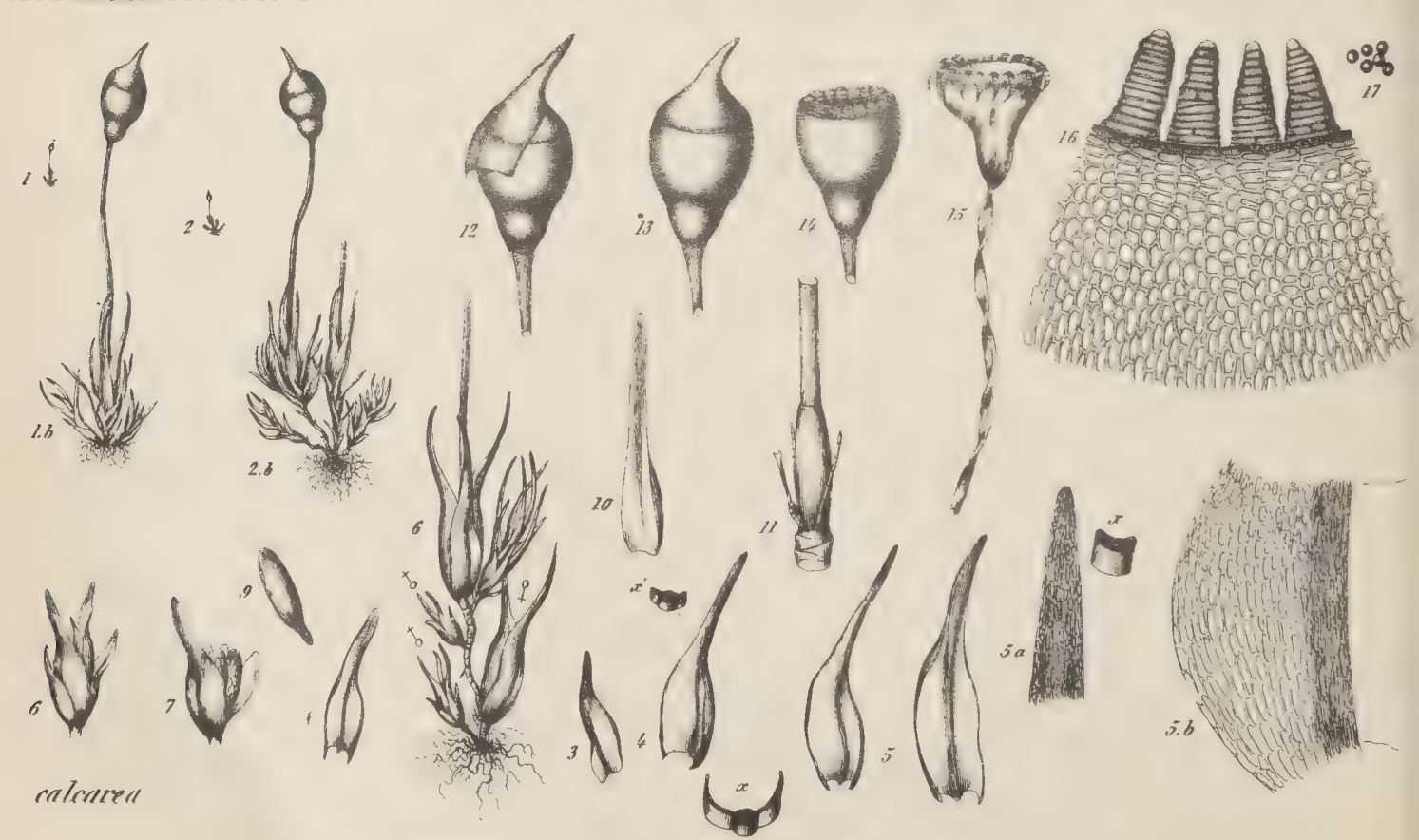


PLATE XXXIV.

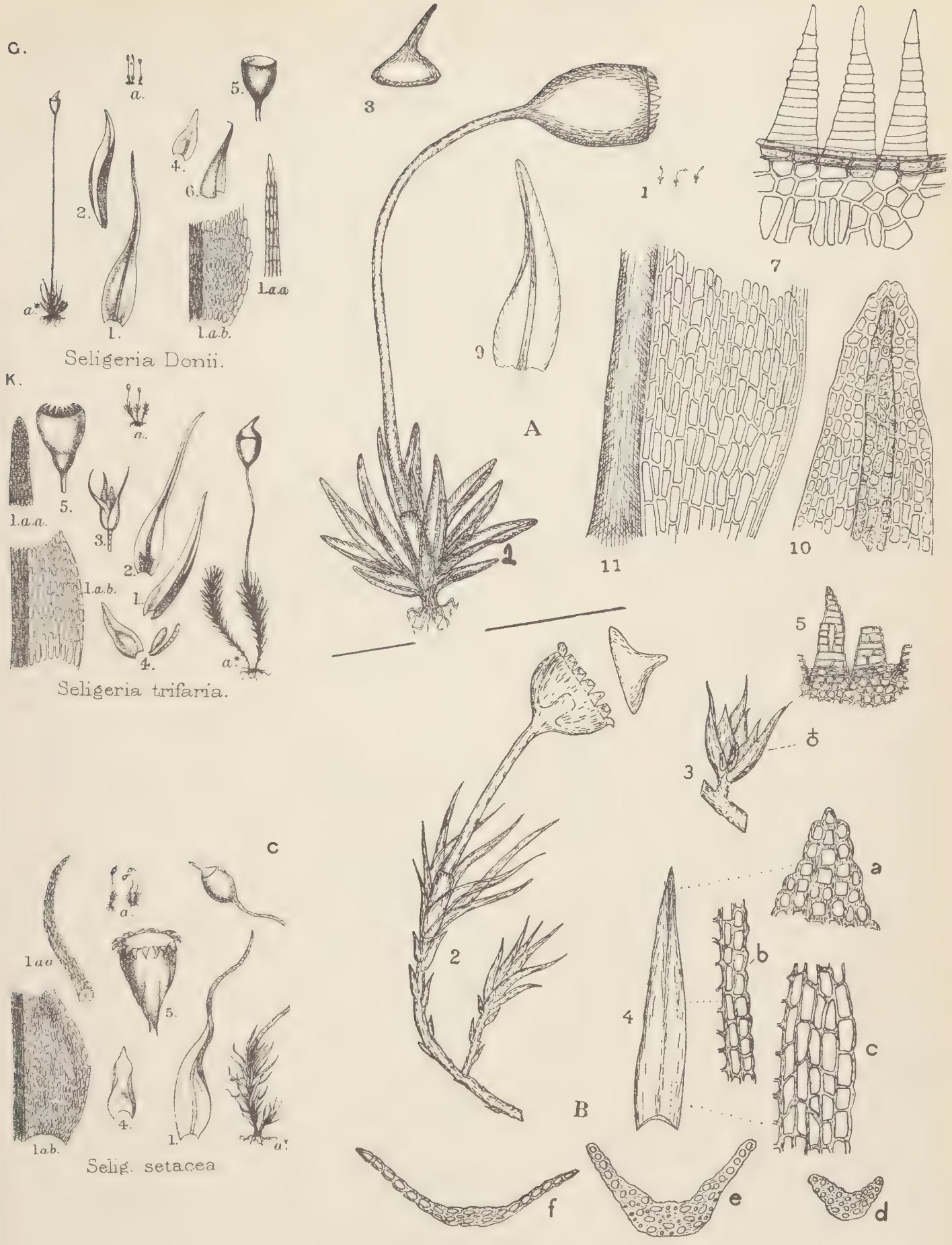
PLATE 34. *Seligeria pusilla* (from Bry. Eur. *pl. 110*). 1, 2, 3, plants × 1; 1*b*–3*b*, plants enlarged; 6*a*, 6*b*, cells of leaf apex and base respectively; 4–7, leaves; 8, base of plant stripped to show ♂ and ♀ buds; 9, 10, 11 male bud, perigonial leaves and antheridia; 12–15, perichaetial leaves; 16, vaginula and base of seta; 17–19, capsules; 20, ¼ mouth of capsule and 4 peristome teeth; 21, spores.

S. calcarea (from Bry. Eur. l. c.). 1, 2, plants; 1*b*, 2*b*, plants enlarged; 3–5, stem leaves; 5*a*, 5*b*, cells of leaf apex and base respectively; base of plant stripped to show ♂ and ♀ buds; 6–8, ♂ bud, perigonial leaves and antheridia; 9, antheridium; 10, perichaetial leaf; 12–15, capsules; 16, portion of capsule mouth with peristome teeth; 17, spores.

PLATE 35. *Seligeria Doniana*, *S. trifaria*, and *S. recurvata* (*setacea*) (from Braithw. Brit. Moss Fl. **1**: *plates 16* and *17*). Description as for *plate 18A–F*.

A. *Seligeria campylopoda* (from Bull. N. Y. Bot. Gard. **2**: *pl. 35*). 1, plants × 1; 2, plant enlarged; 3, operculum; 9, leaf; 10, 11, cells of leaf apex and base respectively; 7, peristome teeth and upper exothecial cells.

B. *Seligeria tristichoides* (from Bryol. **5**: 8. *figs. 2–5*). 2, plant much enlarged; 3, ♂ bud, 4, leaf with cells as indicated in *a–c*; *d–f*, cross sections of leaf, basal, median and apical; 5, portion of peristome.


G.
a.
5.
4.
6.
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a*
1.
1.a.a
1.a.b.
Seligeria Donii.
K.
a.
1.a.a.
5.
3.
2.
1.
1.a.b.
4.
a*
Seligeria trifaria.
c
a.
1.a.a
5.
4.
1.
a*
1.a.b.
Selig. setacea
3
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PLATE XXXV.

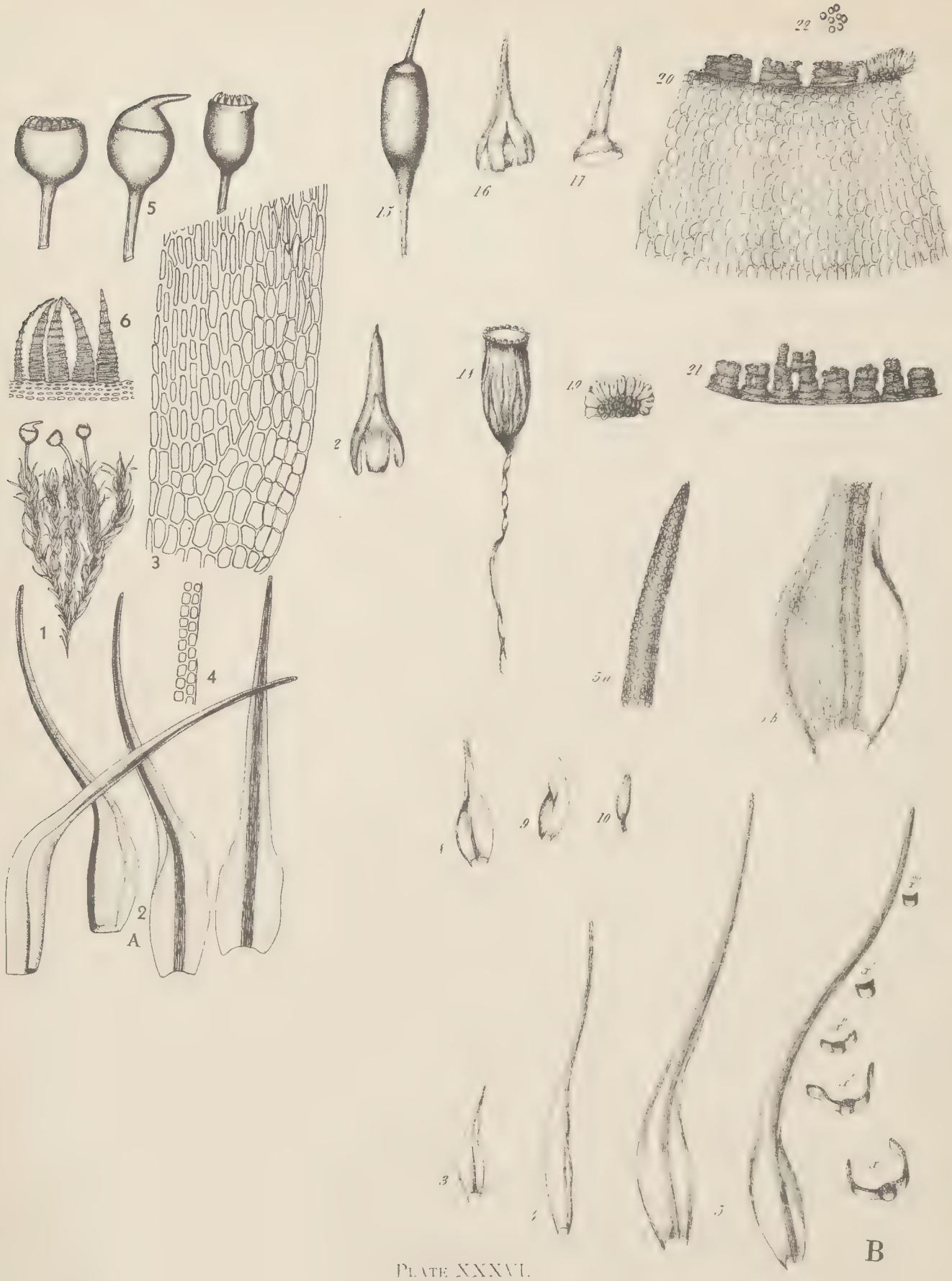


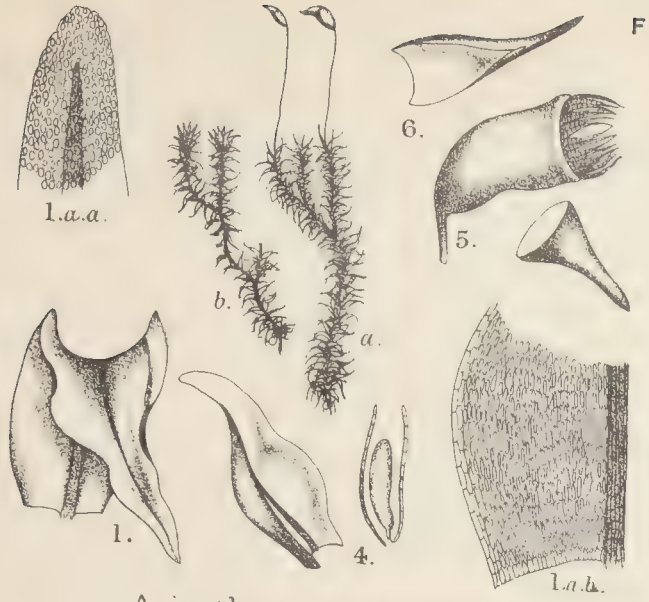
PLATE XXXVI.

PLATE 36. *A*. *Seligeria polaris*. 1, plant × 3; 2, leaves × 20; 3, basal cells × 200; 4, upper marginal cells × 200; 5, capsules × 13; 6, peristome teeth × 50 (drawings by Seville Flowers from specimens from arctic America).

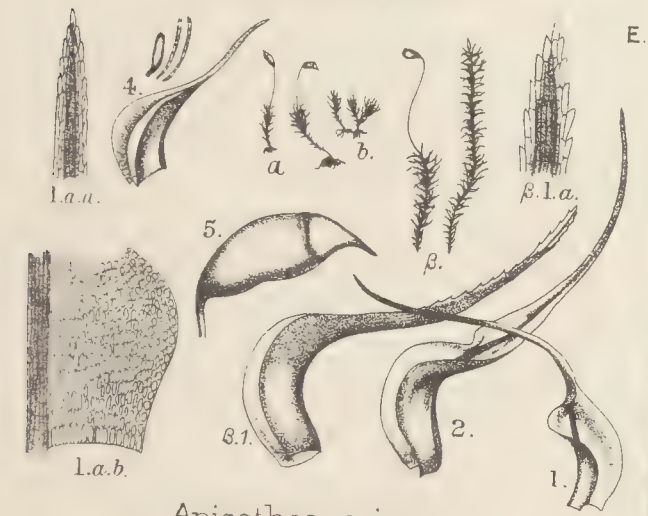
B. *Brachydontium trichodes* (from Bry. Eur. *pl. 115*). 3–5, leaves; 5*a*, 5*b*, areolation of leaf apex and base respectively; 8, 9, perigonial leaves; 10, antheridium; 12, 16, calyptrae; 15, fresh operculate capsule; 18, old dry capsule; 17, operculum; 19, annulus; 20, exothecial cells, portion of peristome and annulus; 21, peristome teeth; 22, spores.

PLATE 37. *Dicranella squarrosa*, *D. Grevilleana* (as *Anisothecium*), and *D. Schreberi* (as *Anisothecium crispum*) (from Braithw. Brit. Moss Fl. **1**: *pl. 16, figs. F, E, D, respectively*). *Dicranella crispa* and *D. subulata* (as *D. secunda*) (from Braithw. l. c. *pl. 15, figs. D, E,* respectively). Description as for *Pl. 18A–F.*

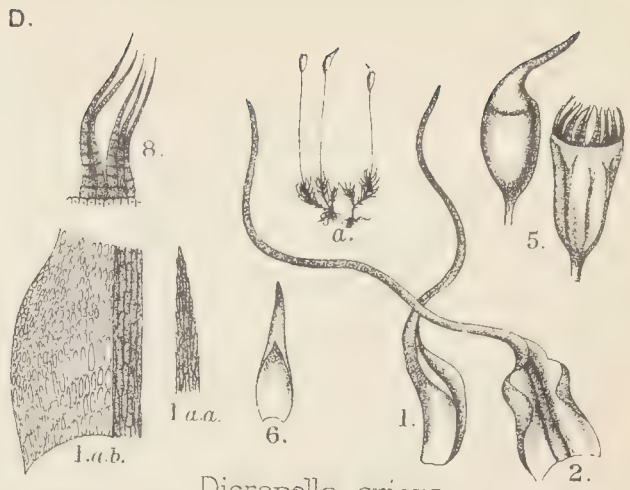
A. Dicranella Herminieri (from Bot. Gaz. **19**: *pl. 21A*, as *D. leptotrichoides*). *a*, plants; *b*, *b*, leaves; *c*, cells of basal leaf border; *e*, *f*, capsules; *g*, portion of annulus; *h*, two peristome teeth.



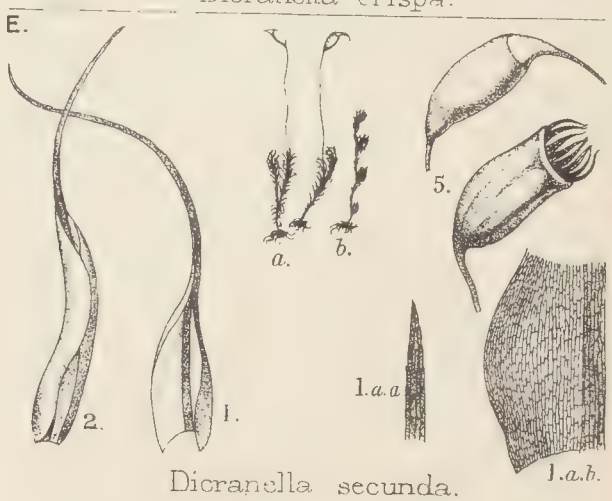
Anisothec. squarrosum.



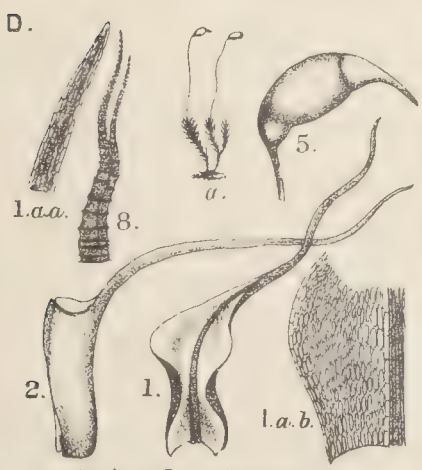
Anisothec. crispum.



Dicranella crispa.



Dicranella secunda.



Anisoth. Grevillei.

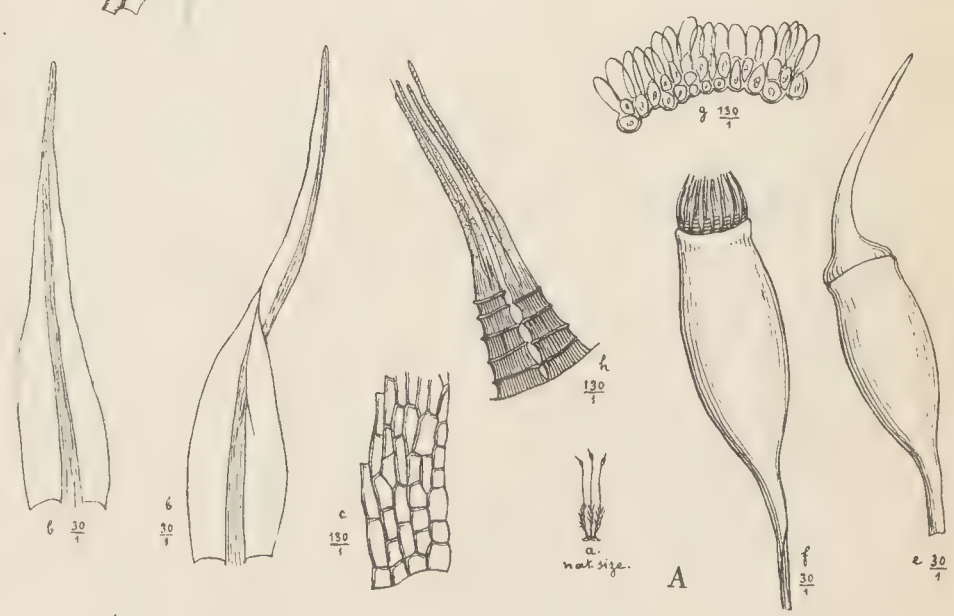


PLATE XXXVII.

DICRANUM DEBILE, Hook et Wils.

PLATE XXXVIII.

PLATE 38. *Dicranella Hilariana* (from Sull. Icones Musc. *pl. 20*, as *D. debile*). 1, plants × 1; 2, 3, ♀ and ♂ plants; 4–8, leaves; 9, 10, cells of leaf base and apex respectively; 11, cross sections of leaves; 12, 13, capsules; 14, part of the peristome with spores; 15, longitudinal section of the same; 16, operculum; 17, 18, perigonial leaf and antheridium.

MOSS FLORA

OF

NORTH AMERICA

North of Mexico

BY

A. J. GROUT, PH.D.

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POLYTRICHACEAE

BY

DR. T. C. FRYE

University of Washington

CALYMPERACEAE

BY

DR. WILLIAM C. STEERE

University of Michigan

VOLUME I

Part 2

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NEWFANE, VERMONT

AUGUST, 1937

2. ANGSTROEMIA Bry. Eur. fasc. 33–36. 1846.

Plants with the habit of an *Anomobryum* but the peristome of a *Dicranum*. We have only the type species, *A. longipes*.

ANGSTROEMIA LONGIPES (Sommerf.) Bry. Eur. l. c.

Weisia longipes Sommerf. Suppl. Fl. Lapp. 52. 1826.
Dicranum julaceum Hook. in Drumm. Musc. Am. 100. 1828.

Plants gregarious or in loose thin mats; stems filiform, julaceous, small, mostly 5 mm. or less in height, rarely up to 1 cm., bearing single branches from just below the perigonial or perichaetial leaves; lower stem leaves minute, scale-like, appressed, ovate, rather obtuse, 0.5–1 mm. long, upper and perichaetial leaves much larger, ovate-lanceolate and the latter acuminate, about 1.5 mm. long, entire or nearly so; costa strong, vanishing a little below the apex, flattened, with a small stereid band; leaf cells very smooth, rather irregular, above elongated-hexagonal and rhomboidal, below oblong-rectangular, median 8–15 x 30–60 μ, narrower at the margin, linear in acumination. Dioicous; male flowers terminal and conspicuous; seta 4–12 mm. long, smooth; capsule ovoid, erect and symmetric, about 0.6–1 mm. long, apparently without stomata; operculum long-conic to short-rostrate; annulus lacking; peristome teeth reddish, entire, perforate, or rarely divided nearly ½ the way down, more or less striate longitudinally; spores nearly smooth, up to 22 μ; mature in summer. Type locality, Lapland.

ILLUSTRATIONS:—Bry. Eur. *pl. 94;* Limpr. Laubm. **1**: 303. *f. 111; Pl. 39.*
EXSICCATI:—Drumm. l. c.; Macoun, Can. Musci 11a, 25.
On moist banks; Greenland; Alaska to British Columbia; rare.

3. RHABDOWEISIA Bry. Eur. fasc. 33–36. 1846.

Plant small, up to 3 cm. high, usually much less, in dense tufts or cushions; stems without central strand, densely foliate, radiculose at base and more or less branched above; leaves linear-lanceolate, acute, more or less crisped when dry, spreading-flexuous when moist, plane-margined, nearly or quite smooth; costa stout, ending just below the apex, in cross section with a band of guide cells having a strong stereid band below and none or a very faint one above; lamina cells short, subquadrate and rounded above; basal more elongated, rectangular and paler, with alar cells not differentiated. Autoicous; ♂ buds mostly on short stalks just below the perichaetium; seta erect, 2–5 mm. long; capsule exserted, erect, symmetric, less than 1 mm. long, ovoid to short-oblong, deeply 8-plicate when dry and empty, with a few stomata at base; calyptra cucullate, smooth, not fringed at base; operculum with a long oblique beak; annulus lacking; peristome teeth narrow, often filiform above, without median line, smooth to faintly papillose or striate.

Type species: *R. fugax*.

KEY.

Leaves serrulate above; peristome teeth wider, tapering gradually from a broader base.. *1. denticulata.*
Leaves nearly or quite entire; peristome teeth abruptly filiform from a short wide base.... *2. fugax.*

RHABDOWEISIA DENTICULATA (Brid.) Bry. Eur. fasc. 33–36. *pl. 42.* 1846.

Weisia denticulata Brid. Musc. Recent. Suppl. **1**: 108. 1806.
Rhabdoweisia crispata (Dicks.) Kindb. Eur. & N. Am. Bryin. 211. 1897.

Plants light- to dark-green in short dense sods; stems mostly less than 1 cm. long; leaves oblong- to linear-lanceolate, smaller below, above longer, up to 2–3 mm. and rather crowded, typically closely and finely *serrulate above*, but often with the teeth few and distant, keeled above, narrowly to broadly acute; costa not quite percurrent, *nearly or quite smooth on the back;* upper leaf cells mostly rounded-quadrate, in 7–11 rows in the upper middle of the leaf, 8–17 μ in width, larger near the costa, smaller and sometimes transversely elongated at the margins, smooth or somewhat bulging; basal cells much larger, thinner-walled and hyaline, rectangular, extending up to about ¼ of the leaf along the costa but not so far along the margin. Seta erect, 2–5 mm. long; capsule ovoid, urn 0.5–1 mm. long, operculum somewhat shorter; peristome teeth linear from *a lanceolate base*, smooth to slightly striate and papillose; spores about 17 μ, slightly roughened, mature in summer. Type locality, England.

ILLUSTRATIONS:—Bry. Eur. l. c.; Limpr. Laubm. **1**: *f. 103;* Braithw. Brit. Moss Fl. **1**: *pl. 26B; Pl. 39.*
EXSICCATI:—Drumm. Musc. Am. 68 (as *Weisia striata*); Holz. Musc. Acro. Bor. Am. 78 (as *R. fugax*); Grout, Musci Perf. 10.

Clefts of ledges in cool moist shaded elevated regions; Newfoundland to Alaska; south to N. Carolina, Tennessee, Missouri and Manitoba.

Williams seems to be correct in thinking that we do not have true *R. fugax* (Hedw.) Bry. Eur. north of Mexico, but the leaves of much of our material are intermediate. For these forms I have adopted Dr. Culman's manuscript name given in a letter to Holzinger about his 446. True *fugax* has the leaves narrower at the apex, with fewer rows of cells at the middle, margins entire or nearly so, upper cells more rounded and with thicker walls and the peristome teeth are *abruptly filiform from a broader base*, not tapering as in *denticulata. Pl. 40.*

Most of our plants average narrower and less serrate leaves than the European and I have seen no American plants with leaves as broad (15 rows of cells) or so strongly serrate as Husnot's Musc. Gall. 401, and I have seen no European plants to match the narrow, nearly entire leaves of Austin's 71 or Holzinger's 446, but some American plants almost exactly match some European and the peristomes of all seem to be the same.

Var. AMERICANA Culman Ms. **n. var.**

Leaves narrowly acute and sometimes almost entire. *Pl. 48.*

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 446 (type); Austin Musc. Appal. 72 & 71 (as *R. fugax*). Also W. Virginia (Ammons).

With the range of the species east of the Mississippi. The North American plants of our range referred to *R. fugax* are almost wholly this variety.

4. OREOWEISIA DeNot. Atti Univ. Genova **1**: 489. 1869.

Small tufted rock-growing mosses, rarely, if ever, found except where lime is present. Differing from *Dichodontium* chiefly (in our species) in having the peristome teeth mostly undivided and without median line. Type species, *O. serrulata.*

OREOWEISIA SERRULATA (Funck) DeNot. l. c.

Weisia serrulata Funck; Brid. Bryol. Univ. **1**: 804. 1827.
Oreoweisia serrulata var. *tenuior* Kindb.; Macoun, Cat. Can. Pl. **6**: 15. 1892.
Oreoweisia obtusata Kindb. Rev. Bryol. **23**: 18. 1896.

Plants in compact tufts, light to dark green above, often compacted with soil below; stems 1–5 cm. long, slender, little branched, with radicles more or less papillose; leaves lanceolate to narrowly oblong, from an erect subclasping base widely spreading to squarrose when moist, when dry incurved-crisped, acute to obtuse, in our sterile plants seldom over 1 mm. long, ususally less (according to Williams and Brotherus reaching 2.5 mm.), deeply keeled; margins plane above, more or less recurved in the middle, finely and rather closely and evenly serrulate by projecting cells, with these teeth larger at the apex; costa strong, papillose on the back, ending a few cells below the apex, in cross section near the middle showing 2–4 median guide cells *with stereid bundles on the lower side only*, with only the large outer cells on the upper surface and differentiated papillose cells at the back; upper leaf cells obscure, pointed-mamillose on both sides, roundish to nearly square, arranged in longitudinal rows, about 12 μ wide; basal cells larger, rectangular and smooth, quadrate along the basal margin; alar not differentiated; perichaetial leaves little different. Autoicous; seta erect, about 5 mm. long; capsule oblong, erect and symmetric or nearly so, up to 1.2 mm. long, neck short and inconspicuous; operculum long-conic to short-rostrate; calyptra cucullate, relatively large, smooth above, not fringed at base; annulus lacking; peristome teeth slender, separate nearly to the capsule mouth, mostly undivided and without median line, articulate, nearly smooth; spores 18–24 μ in diameter, rough, mature in September. Type locality, Switzerland.

ILLUSTRATIONS:—Bry. Eur. *pl. 27;* Limpr. Laubm. **1**: 296. *f. 108; Pl. 40.*
EXSICCATI:—Aust. Musc. Appal. 70.

On moist shaded ledges in cool or elevated regions; rare and found fruiting in N. America in Alaska only. Southern Vermont, Ontario, Minnesota, Wyoming, British Columbia and Alaska; south to New Jersey, Tennesse and Kentucky; abundant in Palenville Cove, Catskill Mts., N. Y.

Often confused with *Dichodontium pellucidum*, for distinctions see under that species. European plants apparently have larger leaves and more strongly papillose radicles.

5. DICHODONTIUM Schimp. Coroll. 12. 1855.

Plants in yellowish to dark-green cushions, compact to loosely tufted, usually growing in moist places by rocky streams; stems with a central strand, radiculose in the older parts with *smooth* radicles; stem leaves contorted to crisped when dry, oblong or ovate to linear-oblong; costa strong, not quite reaching the apex, in cross section with stereid bands above and below the guide cells; upper leaf cells nearly square or rounded-quadrate, papillose-mamillose with a large papilla on each surface, obscure; basal cells larger, more elongated, smooth and clearer; alar not differentiated. Dioicous; capsule long-exserted on a long smooth seta but often overtopped by innovations; capsule oblong to ovoid, symmetric or slightly curved, erect or inclined; operculum conic-rostrate; annulus wanting; peristome dicranoid; calyptra cucullate, entire at base, often somewhat rough above. Type species, *D. pellucidum*.

1. Dichodontium pellucidum (L., Hedw.) Schimp. l. c.

Dicranum pellucidum Hedw. Sp. Musc. 142. 1801.
Dichodontium flavescens (Dicks.) Lindb. Bot. Not. **1878**: 113. 1878.
Dichodontium subflavescens Kindb.; Röll, Hedwigia **35**: 59. 1896.

Plants in small tufts to large sods, yellowish- to dark-green, brown below, radiculose to near the new growth, often bearing in the leaf axils globular stalked brood-bodies or protonema-like filaments (see Correns, Untersuchungen, *figs. 1 & 2*); stems slender, 1–10 cm. long, little branched, but often with slender subapical innovations; leaves ovate-lanceolate to lingulate with a broad clasping base or narrowly oblong-lanceolate, acute to narrowly obtuse, nearly entire or finely and evenly serrulate by projecting cells or even coarsely and irregularly serrate above, 1–5 mm. long; when dry usually somewhat incurved and variously contorted and twisted; when moist widely spreading to squarrose; margin recurved below, often somewhat undulate above; costa stout, ending below the apex, rough on the back above, in cross section near the middle showing about 4 guide cells *with stereid bands above and below* and much larger outer cells; upper leaf cells irregularly quadratic, obscure (or nearly pellucid in forms), 8–12 μ in diameter, conic-mamillose on both sides, these quadrate cells *running in several rows down the margins nearly to the insertion;* median basal cells rectangular, reaching 1 : 4, smooth, rather pellucid; alar cells not differentiated; perichaetial leaves little different except without quadrate marginal cells at base, longer and often broader at base. Dioicous; seta erect, 1–2 cm. long, yellowish; capsule oblong to ovoid, nearly erect and symmetric to curved and inclined, 1.5 mm. or more in length, more or less contracted under the mouth when dry, smooth; operculum conic-rostrate, sometimes nearly as long as the urn; peristome teeth dark-reddish, divided mostly into two prongs about half way down, more or less striate below the forks and papillose above, sometimes without these markings; basilar membrane extending 2–3 rows of cells above the capsule mouth; spores slightly rough, 14–20 μ in diameter, mature late autumn to early spring. Type locality, European.

Illustrations:—Bry. Eur. *pl. 50, 51;* Limpr. Laubm. **1**: 299. *f. 109, 110;* Braithw. Brit. Moss. Fl. *pl. 24D; Pl. 40.*

Exsiccati:—Drumm. Musc. Am. 108; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 60, as var. *americanum;* Aust. Musc. Appal. 76; R. & C. Musc. Am. Sept. 355; Holz. Musc. Acro. Bor. Am. 585, 586, 609, 438 (as *Oreoweisia serrulata*); Allen, Mosses Cascade Mts. 13, 14; Macoun, Can. Musci 402, 451; Grout, Musci Perf. 110, as var. *serratum.*

Found along rocky streams in cool moist places, sometimes in water, often where lime is present; Labrador to Alaska, south to New Jersey, Pennsylvania, Great Lakes region, Idaho, Montana, and California.

Fruiting rather infrequently and in the western part of its range only.

This species varies greatly in almost all parts of the plant, but these variations do not seem to be correlated in any manner sufficient to define varieties even. Mr. H. N. Dixon (Rev. Bryol. **30**: 39–43. 1903) has noted the most important of these variations as follows:

Plants green or yellowish; plants short, slender, *or* tall and robust; leaves closely set, shortly oblong-lingulate, when dry curled and incurved closely towards the stem, *or* leaves looser, much longer, linear-lanceolate from a distinct base, tapering, when dry flexuose or twisted but still spreading, not incurved; margin entire, crenulate, or serrulate towards apex, *or* leaves often strongly serrulate to the middle of the leaf or below; upper cells obscure with strong papillae, *or* upper cells pellucid, lightly papillose to nearly smooth; basal cells with several marginal rows of quadrate ones reaching to the base, *or* only one or two rows of quadrate cells to base; capsule ovoid, inclined, slightly curved and gibbous, *or* capsule oblong to

subcylindric, erect and symmetric; dorsal surface of purple-red regular peristome teeth covered to near apex with vertical striae, with basal membrane of 4–8 articulations, *or* orange-red more irregular teeth without vertical striae, coarsely papillose above, with basal membrane of 2–3 articulations. Plants having the first set of characters would be ideal *D. pellucidum* and those having the second set, ideal *D. flavescens* but such plants do not occur. Plants with strongly serrate leaves are the var. *serrulatum* Schimp., Musci Perfecti 110, is a good example. Several other varieties have been described but their characters have been included in the above descriptions.

D. pellucidum and *Oreoweisia serrulata* are not infrequently confused as in the case of Holzingers 438. The following are the most obvious distinctions; *Oreoweisia* has the larger radicles more or less papillose, no brood bodies, basal marginal cells shorter but much less distinct from the median basal, cross section of costa with no stereid band above the guide cells; peristome teeth without median line, only occasionally divided. *D. pellucidum* has non-papillose radicles, brood bodies frequently present in leaf axils, marginal basal cells as described above, median cross section of costa with stereid bands above and below guide cells (but not always in other sections). Peristome teeth without median line, mostly undivided.

Very slender forms like Holzinger's 586 & 509 closely resemble *Dicranella* in macroscopic appearance. 509 with its short, relatively broad leaves seems correctly referred to var. *fagimontanum* (Brid.) Schimp. and is strikingly different from the general run of specimens.

The capsules of var. *americanum* (Lesq. & James, Man. 62) from Brattleboro, Vt. (Frost) are very slightly strumose as are some of Allen's 14.

2. Dichodontium olympicum R. & C. Rev. Bryol. **19**: 74. 1892.

Plants in compact dark green cushions, scarcely 1 cm. high; leaves less than 2 mm. long, contorted-appressed when dry, when moist spreading to recurved, oblong-lanceolate to almost lingulate, rounded-obtuse to obtusely acute; *margins plane, not serrate but papillose-crenulate, more strongly so near the base; costa rough with finer sharp papillae almost to the insertion; upper leaf cells obscure, about 7 μ in width, papillose with fine sharp papillae, which are sometimes forked; capsule slightly strumose;* peristome teeth more or less longitudinally striate below. Type locality, Olympic Mts., Washington (Henderson).

Illustrations:—Bot. Gaz. 30: *pl. 2, f. 1; Pl. 41 & 48.*

On bluffs near the snow line; known from the type locality only. Type collection seen through the courtesy of the N. Y. Botanical Garden and R. S. Williams.

The plane margins, sharper papillae and strumose capsule seem to characterize this form sufficiently for specific rank.

6. ONCOPHORUS Brid. Bryol. Univ. 389. 1826.

Cynodontium Schimp. Coroll. Bry. Eur. 12. 1855. Not of Brid. 1806.

Plants of small or medium size, growing in compact tufts or more extensive sods, bright to yellowish green; leaves mostly crisped when dry, not falcate-secund, when moist erect-spreading to squarrose, narrowly to broadly lanceolate, smooth to highly papillose or mamillose; margins entire or serrate, usually of two layers of cells, and more or less recurved (except in *O. Wahlenbergii*); costa from nearly percurrent to excurrent, in cross section with guide cells and more or less developed stereid bands above and below (except *O. strumulosum*); upper median leaf cells small, rounded-quadrate to irregular, often obscure; cells in lower part of leaf elongated, rectangular, mostly hyaline and without pitted walls; alar cells often somewhat differentiated in *virens* and *polycarpus*, but scarcely so in the other species. Autoicous; ♂ buds below perichaetium; seta long exserted, straight or curved; capsule erect and symmetric to curved and horizontal, smooth or striate when dry and empty, sometimes strumose; stomata mostly in one row at base of spore sac; peristome teeth 16, mostly divided at least half way down into two papillose forks and longitudinally striate on the outer side (merely perforate in *O. Schisti*); operculum beaked; spores rough. Type species, *O. polycarpus.*

Key.

1.	Leaves strongly papillose above (*tenellus* may be sought here)	2.
	Leaves faintly or not at all papillose	7.
2.	Leaves 1.5 mm. long or less, rounded-obtuse (doubtfully N. American)	6. *alpestris.*
	Upper leaves reaching 2 mm. or more in length, if shorter acute	3.

3.	Border of leaf of a single layer of cells	6.
	Border of a double layer of cells	4.
4.	Capsules strumose	*1a.* var. *strumiferus.*
	Capsules not strumose	5.
5.	Peristome teeth not divided, sometimes perforate	*7. Schisti.*
	Peristome teeth forked, divided at least ½ the way down	*1. polycarpus.*
6.	Upper leaf cells obscure, mostly 6–8 μ wide	*4. gracilescens.*
	Upper leaf cells distinct, mostly 9–15 μ wide	*5. strumulosus.*
7.	Capsules not strumose	8.
	Capsules strumose	10.
8.	Annulus large, dehiscent	9.
	Annulus lacking or narrow and persistent	*3. tenellus.*
9.	Leaf cells 12–20 μ wide, absolutely smooth	*2. Jenneri.*
	Leaf cells mostly less than 12 μ wide, more or less papillose	*1. polycarpus.*
10.	Leaf base ovate; alar cells usually quite distinct; leaf margin mostly of 2 layers of cells and recurved	*8. virens.*
	Leaf base obovate; alar cells usually not distinct; leaf margin often not recurved	11.
11.	Plants light-green, usually on decayed wood; upper lamina of leaf unistratose	*9. Wahlenbergii.*
	Plants fulvous, usually on rocks; upper leaf lamina bistratose	*10. Rauei.*

1. ONCOPHORUS POLYCARPUS (Hedw.) Brid. Bryol. Univ. **1**: 397. 1826.

Fissidens polycarpos Hedw. Sp. Musc. 159. 1801.
Dicranum polycarpum Bry. Eur. fasc. 37–40. *pl. 47.* 1847.
Cynodontium polycarpon Schimp. Coroll. Bry. Eur. 12. 1855.

Plants in compact soft green sods, tomentose within, stems reaching 5 cm. long, mostly shorter, branching; leaves crisped when dry, spreading when moist, rarely reaching 5 mm. long, lanceolate to ovate-lanceolate, acute, keeled above; margins mostly bistratose, more or less recurved, irregularly serrate above, somewhat wavy; costa nearly percurrent to excurrent, often rough on the back above; upper leaf cells rounded-quadrate or irregular, 8–12 μ wide, more or less papillose on both sides; lower cells more elongated, rectangular, paler, smooth; alar cells rarely noticeably differentiated, sometimes wider; perichaetial leaves sheathing ½ the way up. Autoicous; seta yellowish, 8–10 mm. long, straight and erect; capsule erect or slightly inclined, oblong-cylindric, when dry and empty plainly ribbed and somewhat contracted under the mouth; annulus large; operculum irregularly crenulate around the base, with a slender oblique beak nearly ½ as long as the capsule; peristome teeth reddish, divided to below the middle, longitudinally striate below, papillose at apex; spores rough, 20–24 μ in diameter, mature in summer. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 47;* Braithw. Brit. Moss Fl. **1**: *pl. 25E;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 9M;* Limpr. Laubm. **1**: *f. 106; Pl. 42.*
EXSICCATI:—Drumm. Musc. Am. 107; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 45, (Ed. 2) 58.
Crevices in mountain ledges, rare; Greenland to Alaska, south to Lake Superior and Montana.

1a. Var. STRUMIFERUS (DeNot.) **n. comb.**

Fissidens strumifer Hedw. Sp. Musc. 160. 1801.
Dicranum polycarpum var. *strumiferum* DeNot. Syll. 210. 1838.

Leaves usually more strongly papillose on both sides. Capsule inclined and more or less arcuate, *distinctly strumose. Pl. 42.*

ILLUSTRATIONS:—Bry. Eur. *pl. 47 & 48,* in part as var. β; Braithw. l. c. *pl. 25E;* Dixon, l. c. *pl. 9N.*
With the range of the species but extending into the mountains of New England and New York.
The difference in the capsules as described is very striking, but no other different characters seem constantly correlated with this. The papillosity of the leaves is exceedingly variable.
near [illegible] Mt. Monadnock, N.H.; Catskill Mts, N.Y. (Mrs. Inez M. Haring)

2. Oncophorus Jenneri (Schimp.) Williams, N. Am. Flora **15**[2]: 99. 1913.

Didymodon Jenneri Schimp.; Howie, Trans. Bot. Soc. Edinb. **9**: 314. *pl. 5*. 1868.
Cynodontium polycarpon laxirete Dixon, Handb. Brit. Mosses (Ed. 1) 73. 1896.
Cynodontium polycarpon var. *laevifolia* Hagen, Musc. Norv. Bor. 8. 1898–99.

This has the large annulus and the crenulate-margined operculum of *O. polycarpus* but the plants are larger, capsules longer, up to 2.5 mm., with a neck twice as long; leaves up to 6 mm., wider, especially in the upper part; margins of a single layer, plane farther down from the apex, irregularly serrulate to almost entire; leaf cells larger, *12–20 μ*, more regularly quadrate, *quite smooth*, except on the margin, *more transparent;* spores in May

Illustrations:—Schimp. l. c.; Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 10A; Pl. 41.*
Very rare; Sheep Camp, Dyea Creek, Yukon (Williams); near Olympic Hot Springs, Washington (Foster); Burnside Road, Victoria, Vancouver Id., May 11, 1893 (J. Macoun, as *Cynodontium strumiferum*). This was numbered 63 on a label originally printed as Canadian Musci 612, and is in fine but very slightly immature fruit.

3. Oncophorus tenellus (Bry. Eur.) Williams, N. Am. Flora **15**[2]: 101. 1913.

Dicranum gracilescens tenellum Bry. Eur. fasc. 37–40. *pl. 46γ*. 1847.
Cynodontium alpestre Milde, Bryol. Siles. 51, in part. 1869.
Cynodontium tenellum Limpr. Krypt.-Fl. Schles. **1**: 425. 1877.
Cynodontium torquscens Limpr. Laubm. **1**: 288. 1886.
Cynodontium subalpestre Kindb.; Macoun, Cat. Can. Pl. **6**: 257. 1892.

Plants usually short and compact, very dark except at growing tips, rarely more than 1 or 2 cm. high; leaves linear-lanceolate, up to 3 mm. long. Annulus lacking; operculum nearly entire on margin; peristome teeth mostly split 2/3 the way down. Type locality, Germany.

Illustrations:—Bry. Eur. l. c.; *Pl. 41.*
Exsiccati:—Aust. Musc. Appal. 467; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 57; Holz. Musc. Acro. Bor. Am. 304, 659.
Labrador to Alaska, south to the Mountains of New England, Minnesota and Montana.
While the general run of the plants referred to this species by Williams in the herbarium of the New York Botanical Garden are short and compact with fewer elongated basal cells than in *O. polycarpus*, the only *constant* difference I have been able to find is the lack of annulus. Usually, however, the operculum is less crenulate at base and shorter, the beak, 1.5–2 times the length of the conic base. Also the teeth usually split farther down. As most of the plants hitherto collected are deoperculate, definite determination is difficult. In most cases the spores seem to mature in autumn, though some collected near Lake Michigan seemed to mature in summer.
Perhaps the leaves are never as rough as in *some* plants of *polycarpus*, but they are fully as rough as in other plants of that species.

4. Oncophorus gracilescens (Web. & Mohr.) Lindb. Musci Scand. 27. 1879.

Dicranum gracilescens Web. & Mohr. Bot. Tasch. 467. 1807.
Campylopus cirrhatus Brid. Bryol. Univ. **1**: 479. 1826.
Cynodontium gracilescens Schimp. Coroll. Bry. Eur. 12. 1855.

Plants in compact green tufts, brown and tomentose below; stems branching, up to 5 cm. long; leaves crisped when dry, narrowly lanceolate, up to 3 mm. long, narrowly or obtusely acute; margins of a single thickness of cells, mostly somewhat recurved along the middle portion, papillose-serrulate more than ½ the way down; costa scarcely percurrent, rough on the back in the upper ¾ with upwards-inclined long sharp papillae; upper leaf cells obscure, small, rounded-quadrate, 7–10 μ wide, highly and coarsely papillose; basal cells smooth, rectangular, pellucid, alar slightly or not at all differentiated; perichaetial leaves loosely sheathing, shorter and rather abruptly narrowed to an upper portion which may be very short and smooth in the inner, or longer and rough in the outer. Autoicous; seta erect or more or less flexuous, up to 15 mm. long; capsule short-oblong, symmetric or more frequently slightly unsymmetric and cernuous, not strumose, plainly striate when dry and empty; urn with the short neck 1.5–2 mm. long; annulus lacking; operculum somewhat irregular at the base, with a beak 2/3 the length of the capsule; peristome teeth divided 2/3 the way down into two (rarely 3) slender forks, red and longitudinally striate below, paler and papillose above; spores rough, up to 21 μ, mature in summer. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 45;* Limpr. Laubm. **1**: *f. 105;* Braithw. Brit. Moss Fl. **1**: *pl. 25D; Pl. 42.*

On cool moist ledges, mostly at high elevations or latitudes; very rare; Kakabeca Falls, Port Arthur, Ontario (Macoun, 1869); Near trestle above Tolland, Colorado (Grout, 1914).

What some authors call an annulus consists of two rows of very small cells persistent around the capsule mouth. Dixon's description in Ed. 3 does not seem to fit American and continental plants very closely, they are usually more robust than many forms of *O. polycarpus*. Sterile this species is likely to be mistaken for *Dichodontium pellucidum* from which it differs in the narrower and more acute leaves. In fruit the strongly striate dry capsules distinguish it at once. A careful search through the *D. pellucidum* in American herbaria will doubtless discover more of this rare species.

5. ONCOPHORUS STRUMULOSUS (C. M. & Kindb.) E. G. Britton, N. Am. Flora **15**[2]: 100. 1913.

Cynodontium strumulosum C. M. & Kindb.; Macoun, Cat. Can. Pl. **6**: 16. 1892.

Plants strongly resembling *O. gracilescens*, differing as follows: smaller, about 1.5 mm. high, leaves up to 2 mm. long, narrowly oblong-linear; costa rough on the back about ½ the way down; upper leaf cells distinct, 9–15 μ wide, rounded-quadrate to rectangular or irregular, with papillae about the same or lower; perichaetial leaves longer and narrower. Seta up to 1 cm. long; urn up to 1 mm. long; capsule sometimes strumose, less strongly striate. Type from Hector, Rocky Mts., British Columbia (Macoun). Type examined. *Pl. 45.*

6. ONCOPHORUS ALPESTRIS (Wahlenb.) Lindb. Musc. Scand. 27. 1879.

Dicranum alpestre Wahlenb. Fl. Lapp. 339. 1812.

Distinguished from *O. gracilescens* by the smaller size and rounded obtuse leaves. Reported from Greenland (Lange, Consp. Fl. Groenl. 397. 1880). Apparently there are no specimens in American herbaria. *Pl. 41.*

7. ONCOPHORUS SCHISTI (Wahlenb.) Lindb. Musc. Scand. 27. 1879.

Weisia Schisti Wahlenb. Fl. Lapp. 325. 1812.
Rhabdoweisia Schisti Bry. Eur. fasc. 33–36. *pl. 43.* 1846.
Cynodontium Schisti Lindb. Oefv. Sv. Vet.-Akad. Förh. **21**: 230. 1864.
Cnestrum Schisti Hagen, Kgl. Norsk. Vid. Selsk. Skrift. **1914**: 23. 1915.

Plants in rather compact green sods; stems branching, up to 2 cm. long, usually shorter, tomentose below; leaves crisped when dry, the lower shorter, ovate-lanceolate, the upper much longer, up to 1.8 mm. long, linear-lanceolate, acute, keeled; margin crenulate-serrulate, of two layers of cells, *recurved to below the pellucid cells; costa stout, ending below the apex*, in cross section with two or three median guide cells and a stereid band above and below, the upper band weaker and sometimes failing; upper leaf cells obscure, irregularly quadrate, 7–9 μ wide, *papillose both sides with a single large conical papilla;* basal cells paler, smooth, rectangular; perichaetial leaves little different, perhaps a little more sheathing. Monoicous; ♂ buds on very short stalks just below the perichaetium, 1–4 in number; seta 2–4 mm. long; capsule erect and symmetric, not strumose, ovoid, *urn up to 1 mm. long, ribbed when dry and empty;* annulus wanting; operculum beaked, smooth on the edge; *peristome teeth narrowly lanceolate with very slender papillose points, longitudinally striate below, not forked but occasionally perforate, of the same reddish color throughout, without median line; spores* rough, 10–16 μ in diameter, mature in spring. Type locality, Lapland.

ILLUSTRATIONS:—Bry. Eur. l. c.; Broth. Laubm. Fenn. 71, *f. 15D. Pl. 41.*

EXSICCATI:—Macoun, Can. Musci 15a (according to Willams); Drumm. Musc. Am. 68 (as *Weissia striata*).

On soil near rocks and in crevices in moist cool places at high altitudes and latitudes; Montana and Wyoming to Alaska; also in northern Europe. Keweenaw Peninsula, Mich. (Steere).

In general appearance this species resembles *Rhabdoweisia* more than *Oncophorus*, but is distinguished from all our species by the very strongly papillose cells as well as the bistratose margin, which last also distinguishes it from *Dichodontium* and *Oreoweisia.*

8. ONCOPHORUS VIRENS (Sw., Hedw.) Brid. Bryol. Univ. **1**: 399. 1826.

Dicranum virens Hedw. Stirp. Crypt. **3**: 77. *pl. 32.* 1792; Sp. Musc. 142. 1801.
Cynodontium virens Schimp. Coroll. Bry. Eur. 12. 1855.

Plants in wide rather close sods, bright- or yellowish-green above, brown and radiculose below, reaching 5 cm. or more in height, mostly shorter, branched; leaves not longer above, spreading when moist, crisped when dry, up to 4 mm. long, from an ovate or oblong subclasping base *rather gradually* narrowed to a lanceolate keeled upper portion, acute or subobtuse; margin entire or irregularly serrate, *recurved except near base and apex*, usually of a double thickness of cells; costa from almost percurrent to shortly excurrent, at most only slightly roughened on the back above; upper leaf cells shortly rectangular to quadrate, smooth or somewhat bulging, rather incrassate and rounded, up to 10 μ in width but distinct; basal cells paler, elongated-rectangular, reaching 40 μ in length but not much wider, becoming much shorter about the middle of the basal portion; alar cells in many of the leaves enlarged and inflated; inner perichaetial leaves somewhat more sheathing, longer and more abruptly narrowed. Seta yellowish, up to 3 cm. long; capsule light-brown, oblong, curved and unsymmetric, strumose, urn up to 2 mm. long, smooth or slightly and irregularly wrinkled when dry and empty, and slightly or not at all contracted below the mouth; annulus apparently lacking but very narrow and persistent; operculum long and obliquely beaked; peristome teeth red-brown, divided scarcely ½ the way down, longitudinally striate nearly to the papillose tips on the outer plates, inner plates distinctly papillose; spores slightly rough, in spring (May in British Columbia). Type locality, Lapland.

Illustrations:—Bry. Eur. *pl. 48;* Hedw. l. c.; Braithw. Brit. Moss Fl. **1:** *pl. 25B; Pl. 42.*

Exsiccati:—Drumm. Musc. Am. (as *Dicranum microcarpum*) 105, in part, 106; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 59; Macoun, Can. Mosses 26; Holz. Musc. Acro. Bor. Am. 127; Grout, Musci Perf. 130. (deoperculate).

On moist soil or rocks in cool areas, Greenland to Alaska, south to Quebec, Michigan, Minnesota, Colorado, California, and N. Mexico (Bro. Arsene); rare east of the Rocky Mts. There is considerable variation in the shape of the leaf base and the extent of the reflexing of the margin; some leaves, especially the upper and perichaetial, are a little narrower at the insertion than at the upper base, the inflated alar cells are apparently not developed in the young leaves; there is also considerable variation in the length and curvature of the capsule.

8a. Var. serratus (Bry. Eur.) Limpr. Laubm. **1:** 309. 1886.

Dicranum serratum Bry. Eur. fasc. 37–40. 1847.

Leaves coarsely serrate in the upper part. Various other characters are given by different authors but they do not seem constantly correlated. In American plants the costa seems mostly merely percurrent.

Illustration:—Bry. Eur. *pl. 49* γ.

Exsiccati:—Holz. Musc. Acro. Bor. Am. 277; Macoun, Can. Mosses 28, 488; Grout, Musci Perf. 130 (operculate).

With the typical form, not seen from east of the Rocky Mts. Sometimes on rotten wood.

9. Oncophorus Wahlenbergii Brid. Bryol. Univ. **1:** 400. 1826.

Dicranum Richardsoni Hook. in Drumm. Musc. Am. 104. 1828.
Dicranum microcarpum Hook. l. c. 105 (in part). 1828.
Dicranum virens Wahlenbergii Hueben. Musc. Germ. 231. 1833.
Cynodontium virens Wahlenbergii Schimp. Coroll. Bry. Eur. 12. 1855.
Cynodontium Wahlenbergii Hartm. f. in Hartm. Skand. Fl. (Ed. 10) **2:** 113. 1871.
Dicranum Demetrii R. & C. Bot. Gaz. **22:** 1. 1896.

Differs from the preceding mainly in the characters italicised below. Upper leaves usually the longest, reaching 5 mm., *more strongly crisped, from a more completely sheathing obovate base abruptly narrowed to a longer flexuose subulate upper portion,* which has the margins serrate above (rarely entire) and less often bistratose *and mostly plane;* costa often excurrent and usually somewhat roughened on the back near the apex; elongated basal leaf cells reaching nearly to the shoulder. Type locality, Lapland.

Illustrations:—Bry. Eur. *pl. 49*; Jennings, Mosses Western Pa. *pl. 8;* Braithw. Brit. Moss Fl: **1:** *pl. 25A;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 10D;* M. H. M. *f. 35.*

Exsiccati:—Drumm. l. c.; R. & C. Musc. Am. Sept. 270; Aust. Musc. Appal. 75 (as *Dicranum virens*).

Mostly on decaying wood in moist cool shaded places; Greenland to Alaska, south to Pennsylvania, Ohio and Wyoming. Common in the mountains of New England, but usually occurring in limited quantities.

2a. Var. COMPACTUS (Funck) Bry. Eur. fasc. 37–40. 1847.

Tufts short and dense, leaves crowded, shorter, entire, base narrower. Alaska. An arctic-alpine form.

10. ONCOPHORUS RAUEI (Aust.) **n. comb.**

Syrrhopodon ? Rauei Aust. Bull. Torr. Bot. Club. **6**: 74. 1876.
Dicranum fulvum Hook. of Lesq. & James Man. 70. 1884.
Dicranodontium inundatum Small, Mosses Southern U. S. 51 (nomen nudum). 1897.
Austinella Rauei Williams, Bryol. **14**: 70. 1911.
Symblepharis Rauei Brotherus, Engler & Prantl, Musci (Ed. 2) 201. 1924. (Not previously published by Williams.)

Plants dark yellow-green at the growing tips, fulvous to dark-brown below, growing in extensive mats; stems with central strand and about 3 rows of thick-walled outer cells, up to 3 cm. long, often branching, upper leaves up to 5 mm. long, spreading-flexuous when moist, slightly crisped when dry, from a clasping obovate base about as broad as long, abruptly narrowed to a channelled linear-lanceolate upper portion 3–4 times as long, irregularly serrate on the plane margins fully ½ the way down, often somewhat rough on the back above, bistratose in the upper lamina; costa stout, up to ¼ the width of the leaf base, usually somewhat narrower, semiterete, and protruding on the dorsal side, in cross section with a median row of guide cells and some accessory cells near the surface, a strong stereid band above and below the median guides; basal cells rectangular, mostly incrassate, except at or near the insertion, alar only occasionally inflated; cells of the upper ½ of the broad base incrassate, about 7 μ wide 1–4 : 1, below this point the cells become gradually longer and above shorter, in the upper lamina becoming shorter, quadrate to short-rectangular. Autoicous; antheridial buds in the leaf axils below the perichaetium; sporophyte as in the two preceding, capsule unsymmetric, inclined and strumose; spores in spring. Type locality, Onoko Glen, Pennsylvania.

ILLUSTRATIONS:—Bryol. **14**: 71. *f. 1; Pl. 51.*

On rocks, usually at high altitudes; not rare in the Great Smokies in Tennessee and North Carolina; Blackwater Falls, Cheat River, W. Virginia, July 9, 1878 (J. D. Smith).

The dark fulvous color and rocky habitat easily distinguish this from *Wahlenbergii* with its light color and usual habitat on decayed wood. Under the microscope the stout costa and the small thick-walled cells of most of the broad base are much like those of *virens*, but the shape of the leaves and the plane margins are those of *Wahlenbergii*. After the archegonia are fertilized, the stems increase by innovations. On one stem there were 3 apparently lateral setae and below each a male flower. The dioicous plants previously described were doubtless imperfectly developed. The type of *Syrrhopodon Rauei* and Small's 51 have been studied.

7. SYMBLEPHARIS Mont. Ann. Sci. Nat. II. **8**: 252. 1837.

We have but one species, the type, *S. helicophylla.*

SYMBLEPHARIS HELICOPHYLLA Mont. l. c.

Symblepharis Oerstediana C. Muell. Syn. **2**: 613. 1851.
Symblepharis Chrismari C. Muell. l. c. 614.

Plants in large soft cushions, yellow-green; stems more or less branching, 2–4 cm. long, tomentose below, with a large central strand; leaves crispate when dry, from a broad obovate clasping base 1 mm. or more in length, rather abruptly narrowed to a widely spreading, slender channelled upper portion 4–5 times as long, with flat unistratose margins, entire or serrulate near the apex; costa percurrent or somewhat excurrent, smooth except at the apex, in cross section near the middle showing a row of 7 or 8 guide cells with a stereid band both above and below; leaf cells smooth, those of the clasping base clear and pale, often brownish, elongated-rectangular up to 12 x 125 μ; cells of the narrower part smaller and denser, 6–8 μ wide and quadrate to short-rectangular; perichaetial leaves similar but with a longer clasping base. Autoicous, antheridial bud short-stalked, at a varying distance below the perichaetium. Setae often aggregate, about 1 cm. long, erect and straight or nearly so; capsule 2–3 mm. long, cylindric, erect and symmetric or nearly so, not strumose, with small stomata at the base, reddish around the mouth; operculum rostrate, much shorter than the urn; annulus lacking; peristome teeth inserted below the capsule mouth, reddish, split well down, more or less striate longitudinally and strongly papillose, especially on the inner face; calyptra not split, slightly rough at apex; spores up to 30 μ, thick-walled, maturing in winter. Type locality, Oaxaca.

ILLUSTRATIONS:—Journ. Linn. Soc. **33**: *pl. 25; Pl. 45.*
EXSICCATI:—Pringle, Musci Mex. 544, 10441.
On decaying wood and probably on soil near top of Mt. Lemon, Pima Co., Arizona, Jan. 15, 1923 (Bartram no. 497). Also Mexico to Panama, and in Asia.
Bartram's plants grew on a log and if sterile could with difficulty be told from *Oncophorus Wahlenbergii*, the leaves are more strongly denticulate above than in the Asiatic plants studied.

8. DICRANOWEISIA Lindb. Oefv. Sv. Vet.-Akad. Förh. **21**: 230. 1864.

Plants small, in dense sods, with branching stems; leaves crisped when dry, lanceolate to subulate from an oblong base, entire, acute to subacute; costa nearly or quite percurrent; upper leaf cells small, nearly isodiametric, rounded-quadrate, smooth or slightly papillose; the lower elongated and hyaline, rectangular; inner perichaetial leaves often broadly obtuse or short-acuminate and sheathing. Autoicous; seta erect, straight, long exserted; capsules oblong to cylindric, erect and symmetric, smooth or irregularly wrinkled when dry but not contracted below the mouth; annulus present or lacking, operculum slenderly beaked; calyptra smooth, not fringed; peristome teeth inserted below the capsule mouth, lanceolate, entire or occasionally split at the apex, usually papillose on the outer face, occasionally somewhat striate near the middle, with median line faint or lacking. Type species, *D. cirrhata.*

KEY.

1.	Leaf margins revolute, alar cells not differentiated	*1. cirrhata.*
	Leaf margins plane, somewhat incurved	2.
2.	Alar cells distinctly enlarged and inflated in many leaves	3.
	Alar cells scarcely different from the other basal	4.
3.	Leaves up to 4 mm. long; subula much longer than the basal part; stereid bands present in costa	*2. crispula.*
	Leaves less than 2 mm. long; subula little or not at all longer than the basal part; costa without stereid bands	*4. subcompacta.*
4.	Subula of perichaetial leaves shorter than the clasping base; capsule oblong	*2a.* var. *contermina.*
	Subula of perichaetial leaves 2–3 times the length of the wider clasping base; capsules ovoid	*3. Roellii.*

1. DICRANOWEISIA CIRRHATA (L., Hedw.) Lindb. l. c.

Weisia cirrhata Hedw. Sp. Musc. 69. 1801.

Plants in close sods, mostly yellowish-green; stems 1–2 cm. long; leaves spreading, flexuous, strongly crisped when dry, gradually linear-lanceolate from a broader lanceolate base, 2–3 mm. long, channelled above, gradually acute or narrowly obtuse; margins entire, *often of a double row of cells above and more or less recurved;* costa vanishing in the apex, 40–60 μ wide at base, smooth on the back above; upper leaf cells rounded-quadrate or short-rectangular, in regular longitudinal rows, 8–12 μ wide, smaller at the margin, smooth, nearing the base growing gradually larger, longer and thinner-walled, at the base about 12 μ wide, 4–6 : 1, shorter near the margin, alar not differentiated; inner perichaetial leaves clasping at base and more shortly acuminate, the innermost often short and broadly obtuse, with a thinner costa. Autoicous; ♂ buds a little below the perichaetium or on a very short branch; seta 6–10 mm. long; capsule oblong-cylindric, erect and symmetric, narrower and darker colored at the mouth, urn 1.5–2 mm. long, pale brown; operculum long-rostrate; annulus present, narrow; peristome teeth red-brown below, paler above and often slightly papillose; spores nearly smooth, up to 16 μ in diameter, maturing late autumn to winter. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 25;* Braithw. Brit. Moss Fl. **1**: *pl. 19F; Pl. 43.*
EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 48; R. & C. Musc. Am. Sept. 202; Allen, Mosses Cascade Mts. 12 (as *D. crispula*); Bartram, Mosses of S. Arizona 5; Holz. Musc. Acro. Bor. Am. 31; Baker, Pacific Coast Bryophytes 581.
On decaying wood bark or trees and occasionally on rocks, British Columbia to California, Arizona, and New Mexico. Frequent in elevated regions west of the divide.

2. Dicranoweisia crispula (Hedw.) Lindb. l. c.

Weisia crispula Hedw. Sp. Musc. 68. *pl. 12, f. 1–6.* 1801.
Weisia convoluta C. M. & Kindb.; Macoun, Cat. Can. Pl. **6**: 14. 1892.

In general appearance resembling the last, but differing clearly in the following particulars; upper leaves reaching 4 mm. in length, from a narrowly ovate or oblong base more rapidly narrowed to a slender roughened subtubulose upper portion, acute at apex and with *the margins incurved;* upper leaf cells averaging smaller, rarely over 8 μ wide, often slightly mamillose at back; alar cells in many leaves (not all) markedly enlarged and inflated, often colored; there is a larger number of more strongly differentiated perichaetial leaves sheathing their whole length, the inner rounded-obtuse to abruptly short-acuminate; annulus lacking; spores a little smaller, mature in early spring.

Illustrations:—Bry. Eur. *pl. 26;* Braithw. Brit. Moss Fl. **1**: *pl. 19E; Pl. 43.*
Exsiccati:—Drumm. Musc. Am. 69; Macoun, Can. Mosses 24.
On rocks in mountains; Alaska to California and eastward in the Rocky Mts.; also in Greenland, Labrador; Mt. Marcy, N. Y.; Mt. Katahdin, Maine; Copper Harbor, Keweenaw Co., Michigan.
Our American plants vary even more widely than the European. The following seem better treated as varieties rather than species.

2a. Var. contermina (R. & C.) **n. comb.**

Dicranoweisia contermina R. & C.; Holz. Contr. U. S. Nat. Herbarium **3**: 269. 1895.

Alar cells as a rule little or not at all differentiated; upper leaf cells often slightly mamillose; inner perichaetial leaves usually abruptly acuminate, often shortly so and often with the acumination consisting solely of the excurrent costa. Holz. Musc. Acro. Bor. Am. 261. Apparently found throughout the western range of the species.

Cardot and Thériot, Proc. Wash. Acad. Sci. **4**: 294, state that they regard *D. contermina* as a variety rather than a species. In Macoun's Can. Mosses no. 24 and in Montana plants sent to Mrs. Britton by Kelsey, some of the capsules are curved and unsymmetric and some are as long as in *D. cirrhata.*

2b. Var. compacta (Schleich.) Lindb. Musc. Scand. 25. 1879.

A stunted alpine form; tufts shorter and thicker; leaves shorter and more obtuse, less crisped; basal cells shorter and broader. Reported by Williams from Montana (Bull. N. Y. Bot. Gard. **2**: 352. 1902) but not noted by him in his treatment of the species in N. Am. Flora **15²**: 96.

D. crispula var. *nigrescens* Nees & Hornsch. is another form mentioned by Holzinger as occurring in Alaska (Pub. Puget Sound Biol. Sta. **3**: 32. 1921). Limpricht, Laubm. 265, says of this that it is scarcely worthy to be called a form.

3. Dicranoweisia Roellii Kindb.; Roell, Hedwigia **35**: 59. 1896.

Plants small, scarcely 1 cm. high; stem leaves crispate, up to 2.5 cm. long, from a lanceolate base gradually narrowed to a long slender acumination, which is strongly papillose-roughened and not serrulate; costa long-excurrent; *upper leaf cells somewhat mamillose at back,* incrassate, rounded-quadrate to short-rectangular, about 7 μ wide; lower leaf cells rectangular and longer, *alar scarcely differentiated; perichaetial leaves more abruptly narrowed from a wider ovate clasping base, the slender subula 2 or 3 times the length of the broad base.* Autoicous; seta less than 1 mm. long; *capsule ovoid, urn up to 1.5 mm. long,* more narrowed at the mouth than in the preceding; peristome teeth papillose throughout. Type locality, Mt. Hood, Oregon, alt. 8000 ft. Also collected on Mt. Rainier, 9000 ft. (Flett). Collected in one other locality on each mountain by different collectors. All four collections in the herbarium of the N. Y. Botanical Garden. Type seen and studied. *Pl. 45.*

4. Dicranoweisia subcompacta Card. & Thér.; Holz. Bot. Gaz. **30**: 122. *Pl. 11, f. 1.* 1900.

Plants in dense cushions; stems branching, up to 8 mm. long; leaves appressed when dry, only slightly spreading when moist, not crisped, reaching 1.5 mm. in length, from an ovate concave base gradually narrowed to a stout or slender acute subula, which may be smooth or somewhat roughened; margin plane, sometimes incurved, entire; costa percurrent to excurrent, in cross section with about 3 median guide cells

and no *stereid bands*, often pale and narrow (below near the base) 15-45 μ wide; upper leaf cells subquadrate, rectangular or irregular, about 10 μ wide, narrower on the margin; the cells in ½–⅔ the leaf base much longer and more pellucid; alar cells in some leaves enlarged and inflated, in others not much different; archegonia and antheridia or sporophyte unknown. Type locality, along the trail from Holzinger's Basin to the Rim, Vicinity of Lake McDonald, Flathead Co., Montana, at base of glacier (Holzinger & Blake, July 1898). Type seen and studied. *Pl. 42.*

There is a striking likeness between this species and *Dicranum hispidulum* Williams, both collected in the same vicinity. The latter has a rough and stouter subula and all but the lower basal cells smaller.

It is probable that this plant should be referred to *Arctoa* rather than *Dicranoweisia* and it may prove to be but a phase of *D. hispidulum*. *D. obliqua* Kindb. Ottawa Nat. **5**: 195. 1892 is, according to Williams, *Dicranum Schisti* (N. Am. Flora **15**[2]: 97.)

9. ARCTOA Bry. Eur. fasc. 33–36. *pl. 86 & 87.* 1846. Emend.

Small plants, mostly less than 3 cm. high, mainly arctic or alpine; leaves mostly lanceolate from a broader base, often secund; costa semiterete, excurrent, in cross section with homogeneous cells, those corresponding to guide cells a little larger; leaf cells more or less incrassate, the lower rarely pitted next the costa; basal cells longer, the alar more or less differentiated and inflated. Autoicous; capsules erect and symmetric (*Euarctoa*) and not strumose, or curved, unsymmetric and strumose (*Kiaeria* Hag.); beak of calyptra often papillose-roughened; peristome teeth divided to the middle, or sometimes merely perforate or split along the median line; annulus usually present, sometimes compound. Type species, *A. fulvella.*

The homogeneous cells of the costa alone would seem to justify treating this group as a distinct genus; the differences in the capsules hardly justify making *Kiaeria* a separate genus from the species originally assigned to *Arctoa.*

Key.

1. Capsules erect and symmetric or nearly so, not strumose; spores 20–28 μ in diameter... 2.
   Capsules curved and cernuous, more or less strumose; spores 13–16 μ in diameter..... 3.
2. Upper leaf cells linear, 2–5 : 1..... *2. fulvella.*
   Upper leaf cells rectangular, 1–2 : 1..... *1. hypoborea.*
3. Alar cells little differentiated; annulus obscure, remaining attached..... *3. falcata.*
   Alar cells differentiated, usually inflated; annulus large, dehiscent..... 4.
4. Leaves usually falcate-secund; upper leaf cells smooth or slightly bulging, median 2–4 : 1; capsules furrowed when dry and empty..... *4. Starkei.*
   Leaves little or not at all secund; upper leaf cells plainly bulging-mamillose, median rarely over 2 : 1; capsule smooth or nearly so when dry and empty..... *5. Blyttii.*

1. ARCTOA HYPERBOREA (Gunn., Smith) Bry. Eur. fasc. 33–36. *pl. 87.* 1846.

Dicranum hyperboreum Smith, Fl. Brit. 1227. 1804.
Cynodontium hyperboreum Hagen, Kgl. Norsk. Vid. Selsk. Skrift. **1914**: 98. 1915.
Dicranella cerviculatula Kindb. Ottawa Nat. **5**: 195. 1892.

Plants in dark-green compact tufts; stems 1–5 cm. long, more or less branching and radiculose; leaves erect-flexuous, somewhat incurved and contorted when dry, erect-spreading when moist, 3–5 mm. long, from an ovate-lanceolate base with incurved margins gradually narrowed to a slender channelled upper portion slightly toothed above; costa about 1/8–1/6 the width of the leaf base, often slightly papillose on the back above, excurrent; leaf cells smooth, incrassate, in the upper part square to rectangular, 8–12 x 10–20 μ, 1–2 : 1, alar cells more or less distinctly inflated and colored; seta erect, 5–8 mm. long, as long or longer than the perichaetial leaves; capsule short-oblong to obovoid, erect and symmetric, or slightly inclined, about 1.5 x 1 mm., furrowed when dry and empty; operculum conic-rostrate with beak oblique; annulus well developed; peristome teeth mostly divided to below the middle, papillose above; spores up to 30 μ, mature in summer. Type locality, Norway.

ILLUSTRATIONS:—Bry. Eur. l. c.; *Pl. 45.*
On rocks; arctic-alpine, very rare; Greenland, Labrador, Hudson Strait; Mt. Hood, Oregon.

The length of the seta is so variable that it is of no use in distinguishing this from the next, but the upper leaf cells as described are very distinctive; leaves with strongly inflated alar cells are rare in this species, but frequent in the next.

2. ARCTOA FULVELLA (Dicks.) Bry. Eur. l. c.

Bryum fulvellum Dicks. Pl. Crypt. Brit. **4**: 10. 1801.

Plants in compact, dark-green tufts; stems branching, 1–3 cm. long; leaves erect-flexuous to somewhat secund; leaves 2–3 mm. long, from an ovate-lanceolate concave base gradually narrowed to a long slender upper portion, which is more or less rough and often serrulate near the apex; margins plane, incurved below and entire; costa long excurrent, 40–60 μ wide at base; leaf cells somewhat incrassate, those in the upper narrow part linear, about 8 μ wide, 15–50 μ long, 2–5 : 1, near the base and costa a little wider and reaching 75 μ in length, often somewhat pitted, marginal cells shorter throughout; alar cells more or less plainly enlarged and inflated, immediately above these a few short-rectangular or quadrate cells; perichaetial leaves longer, sheathing 2/3 their length, often reaching the capsules or beyond, their basal cells longer. Male bud on a more or less distinct branch below the perichaetium; seta 2–4 mm. long, erect, often much shorter than the perichaetial leaves; capsule nearly or quite erect and symmetric, obovoid, with a short neck, urn about 1 mm. long, and sometimes nearly as wide when flattened on a slide, distinctly furrowed when dry, wide-mouthed and subturbinate; operculum short-beaked; annulus narrow, of about two rows of small cells and persistent (in specimens studied); peristome teeth split half way, or merely perforate or slit, red, longitudinally striate with irregular lines and coarsely papillose below, at the tips colorless and nearly smooth; spores rough, up to 24 μ in diameter, mature in July. Type locality, Ben More, Scotland.

ILLUSTRATIONS:—Bry. Eur. *pl. 86;* Limpr. Laubm. **1**: 338, *f. 117;* Braithw. Brit. Moss Fl.: **1**: *pl. 19G. Pl. 43.*

On rocks and in crevices (non-calcareous); White Mts. of New Hampshire; Adirondacks of N. Y.; near Toxaway, N. Carolina (Sharp); Yukon.

Arctoa Andersoni Wich. Flora **42**: 432. *pl. 7*, has been reported from Port Wells, Alaska. The chief distinctions Williams (N. Am. Fl. **15**^{2}: 115, 116) makes are the immersed capsules and split teeth; but not only the Mt. Washington specimens, but also many of the European of *A. fulvella* have the perichaetial leaves extending well beyond the capsule and many of the peristome teeth split ½ the way down. Brotherus (Laubm. Fennosk. 86) describes the leaf base of *fulvella* as oblong and that of *Andersoni* as broadly ovate. Williams (l. c.) does not make this distinction. Most authors also emphasize the shorter capsule, nearly as broad as long, but this also is true of the Mt. Washington plants which have been identified as *fulvella* by every one who has studied them.

The slight roughening at the tip of the calyptra in *fulvellum* is scarcely noticeable

3. ARCTOA FALCATA (Hedw.) **n. comb.**

Dicranum falcatum Hedw. Sp. Musc. 150. *pl. 32.* 1801.
Oncophorus falcatus Brid. Bryol. Univ. **1**: 393. 1826.
Kiaeria falcata Hagen, D. K. N. Vid. Selsk. Skrift. **1914**: 112. 1915.

Plants in compact sods, green above, brown below; stems branching, up to 4 cm. high, usually shorter; leaves typically regularly falcate-secund, especially at the summit of the stems, not much changed in drying, gradually long-linear from a lanceolate base, subtubulose below by the incurved plane margins, entire or subserrulate near apex, 3–4 mm. long; costa usually long-excurrent and rough above with coarse papillae, 1/5–1/7 the width of the leaf base; upper cells of leaf blade *about 6 μ wide, 1–2 : 1, short rectangular to subquadrate,* with moderately thick walls, smooth or bulging-papillose above; lower cells larger, up to 15 x 60 μ; *alar cells only moderately differentiated;* marginal cells smaller nearly throughout; perichaetial leaves from a broader longer sheathing base and having a larger area of larger elongated cells, the inner more abruptly narrowed. Autoicous; male bud close below the perichaetium; seta erect, 5–12 mm. long; capsule 1–1.5 mm. long, ovoid, suberect to cernuous, more or less curved and strumose, smooth or slightly shriveled and contracted below the mouth when dry; *exothecial cells short, rarely over 2–3 : 1, rather thick-walled,* usually with a single row of stomata about the base of the spore sac; operculum rostrate, with beak about ⅔ the length of the urn; *calyptra finely and closely papillose* to near the split base; *annulus poorly developed, of small persistent cells,* scarcely evident as such; peristome teeth red, divided about ½ down, strongly papillose and more or less longitudinally striate below; spores 14–18 μ, mature in summer. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 65;* Braithw. Brit. Moss Fl. **1:** *pl. 20B;* Dixon, Handbk. Brit. Mosses (Ed. 3) *pl. 13E; Pl. 43.*

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 293, 433; Allen, Mosses Cascade Mts. 10.

On rocks and soil in moist shaded places at high altitudes and latitudes; Washington and Oregon, northwards to Alaska.

The characters italicised above will serve to identify perfect fruiting specimens, but depauperate sterile specimens with the leaves papillose above and hardly secund are troublesome. The species is apparently not rare on Mt. Rainier at 5500–7000 ft.

4. ARCTOA STARKEI (Web. & Mohr.) **n. comb.**

Dicranum Starkei Web. & Mohr. Bot. Tasch. 189, 471. 1807.
Oncophorus Starkei Brid. Bryol. Univ. **1:** 394. 1826.
Kiaeria Starkei Hagen, l. c. 114.

Resembles *A. falcata* in many particulars, averaging larger with leaves often less regularly falcate from a broader ovate-lanceolate base, more frequently denticulate farther down from the apex; leaf cells *in the narrower upper portion of the leaf longer, 2–4 : 1; alar cells well differentiated, inflated and brown,* just above these a group of smaller quadrate cells. Capsule oblong, urn up to 2 mm. long, curved, cernuous, more or less strumose, narrowed at the mouth and more or less plainly furrowed when dry and empty; exothecial cells longer with thinner wall; annulus broad, of 2–3 rows of cells, dehiscent; peristome teeth with very coarse papillae and rather faint and irregular longitudinal-oblique lines; calyptra often not quite as rough; spores in summer. Type locality, Silesia.

ILLUSTRATIONS:—Bry. Eur. *pl. 64;* Braithw. Brit. Moss. Fl. **1:** *pl. 20C;* Dixon, Handbk. Brit. Mosses *pl. 13G; Pl. 43.*

EXSICCATI:—Grout, Musci Perf. 91.

Habitat much as in the preceding; mountains of New England; Montana to Washington and north to Alaska, rare.

Williams (N. Am. Flora **15**[2]**:** 118) states that the eastern plants referred to this species "do not seem to be typical." Typical plants are quite distinct but the calyptra varies in roughness, the leaf cells in length, and the upper are often bulging-papillose, also the capsules are in some cases nearly smooth. In other words the four species of the *Kiaeria* subgenus intergrade along some lines. There are considerable differences in the length of leaf cells in this species but they are consistently longer than in any others of the *Kiaeria* group and in American plants the leaf cells in the median portion of the leaf are consistently shorter than in the European, approaching *A. Blyttii.*

5. ARCTOA BLYTTII (Bry. Eur.) **n. comb.**

Dicranum Blyttii Bry. Eur. fasc. 37–40. *pl. 63.* 1847.
Dicranum Schisti (Gunn.) Lindb. Act. Soc. Sci. Fenn. **10:** 11. 1871.
Dicranoweisia obliqua Kindb. Ottawa Nat. **5:** 195. 1892.
Cynodontium Treleasei Card. & Thér. Proc. Wash. Acad. Sci. **4:** 295. 1902.
Kiaeria Blyttii Broth. Laubm. Fennosk. 87. 1923.

At best a subspecies of *A. Starkei* and grading into it in nearly every character in various specimens studied. The leaves are rarely falcate-secund, usually flexuose and somewhat crisped when dry, usually a little shorter; excurrent costa rougher and the upper leaf cells shorter and more conspicuously bulging-mamillose. ♂ buds on the stem well below the perichaetium or on a short branch, sometimes on a separate plant; capsule typically shorter, smooth and less strumose. Type locality, Norway.

ILLUSTRATIONS:—Bry. Eur. *pl. 63;* Dixon, Handbk. Brit. Mosses *pl. 13F; Pl. 43.*

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 229 (as *Dicranum Starkei*).

Crevices of mountain rocks; mountains of New Hampshire and New York; Oregon, Washington and Idaho to Alaska; rare.

The plants from Mt. Washington, New Hampshire, are intermediate between this and *A. Starkei* in leaf structure. The western plants are more like the European.

5a. Var. HISPIDULA (Williams) **n. comb.**

Dicranum hispidulum Williams, Bull. N. Y. Bot. Gard. **2:** 353. *pl. 34.* 1902.

Plants smaller; leaves equally spreading when moist, incurved flexuous when dry, rough on the back in the upper half or more with stout crowded mamillate papillae, broadly ovate-lanceolate, acuminate rather

than long-subulate, scarcely 2 mm. long; leaf cells of the middle lamina about 10 μ wide, 1–2 : 1, quadrate, rectangular or irregular; spores nearly smooth, up to 12 μ in diameter, mature in summer. Type locality, Macdonald Lake, Great Northern R. R., Montana. Also collected by E. T. Bodenberg in three different localities on Mt. Rainier, Washington, alt. about 6000 ft. Holzinger's 229 approaches this variety.

Dicranoweisia subcompacta Card. & Thér. was from the same region as this variety. It is very like *Arctoa Blyttii* except for lack of prominent papillae and it is nearer this than any form of *Dicranoweisia*. *Pl. 44.*

10. DICRANUM Hedw. Fundam. **2**: 91. 1782; Sp. Musc. 126. 1801.

Plants in loose to dense sods, from 2–12 cm. or more in height; leaves broadly to narrowly lanceolate, mostly falcate-secund; costa semiterete, mostly percurrent to excurrent, in cross section near the middle with median guide cells and smaller cells below and above, which usually form distinct stereid bands, often toothed on the back, with or without distinct ribs; upper leaf cells mostly smooth, papillose in a few species; margins unistratose, never recurved above, more or less incurved; alar cells strongly differentiated, enlarged and inflated, often colored. Dioicous, except *D. arcticum;* setae erect, single or clustered; capsules mostly cylindric, erect and symmetric or curved and cernuous and often strumose, operculum long-rostrate; annulus usually well developed; peristome teeth red, inserted near the capsule mouth, confluent at the base, divided about ½ the way down into 2–3 forks, mostly striate vertically on the outside and more or less strongly papillose; calyptra cucullate, not ciliate at base. Type species, *D. scoparium.*

KEY.*

1.	Capsules straight and erect or nearly so, never strumose; leaf cells not pitted except in *D. rhabdocarpum* (*Orthodicranum*); (*D. groenlandicum* may be sought here)	2.
	Capsules curved and cernuous, strumose in some species (*Eudicranum*)	6.
2.	Leaves papillose on the back about ½ the way down, crisped when dry, not secund	*1. montanum.*
	Leaves smooth on the back or slightly rough near the apex, straight, or more or less secund and crisped	3.
3.	Costa excurrent in all leaves	4.
	Costa not excurrent (with rare exceptions and in few leaves)	5.
4.	Plants fulvous except at growing tips; costa with 2 stereid bands; annulus present; nearly always on rocks (except var. a)	*3. fulvum.*
	Plants green to pale green; costa without stereid bands; annulus lacking; usually on wood, rarely on rocks	*4. strictum.*
5.	Stems usually bearing flagella in the axils of the upper leaves, which are somewhat crisped; annulus present; upper leaf cells 1–1.5 : 1	*2. flagellare.*
	Stems without flagella; annulus lacking; upper leaf cells elongate	*5. rhabdocarpum.*
6.	Upper leaf cells 1–2 : 1, rarely more, their walls not pitted	7.
	Upper leaf cells more elongated, more or less pitted	17.
7.	Plants robust; leaves undulate or rugose	8.
	Plants medium sized to slender (except *Muhlenbeckii*); leaves not rugose (except occasionally in *condensatum*)	10.
8.	Leaves erect-open when dry, rarely somewhat crisped, obtuse	*8. Bergeri.*
	Leaves more or less crisped when dry, acute	9.
9.	Leaves ovate to ovate-lanceolate, widest a little below the middle, finely papillose over all the upper dorsal surface; setae solitary	*11. spurium.*
	Leaves oblong-lanceolate, broadest at or near the base, more or less roughened with coarse papillae on the upper dorsal surface; setae usually aggregate	*9. Drummondii.*
10.	Leaves strongly falcate-secund and crisped when dry	*6. fuscescens.*
	Leaves not secund, often straight	11.

* There are 3 species whose slender leaf tips are almost all broken off, *fulvum* var. *viride*, *strictum*, and *fragilifolium;* for distinctions see under the last.

11.	Plants stout; leaves broadly lanceolate, more or less crispate when dry; capsule 3–4 mm. long	12.
	Plants slender; leaves straight or nearly so; capsules rarely over 2 mm. long	13.
12.	Leaves subtubulose above; costa about 1/5–1/6 width of leaf base	*7. Muhlenbeckii.*
	Leaves merely channelled above; costa 1/8 width of leaf base or less	*10. condensatum.*
13.	Leaves with points mostly broken; costa long-excurrent	*12. fragilifolium.*
	Leaves rarely broken; costa ending in apex to shortly excurrent	14.
14.	Leaves blunt, mostly smooth at apex; costa ending in the apex to percurrent	15.
	Leaves acute and slender pointed; costa percurrent to excurrent	16.
15.	Upper leaf cells 1–2 : 1	*15. groenlandicum.*
	*Upper leaf cells 2–4 : 1	*16. laevidens.*
16.	Costa 1/5–1/4 width of leaf base	*13. elongatum.*
	Costa about 1/9 width of leaf base	*14. spadiceum.*
17.	Leaves undulate; setae aggregate	*18. rugosum.*
	Leaves not undulate (sometimes slightly so in *Bonjeani*)	18.
18.	Plants largest of the genus; setae aggregate	*19. majus.*
	Plants less robust or slender; setae solitary	19.
19.	Plants slender; leaves nearly straight, smooth or nearly so	21.
	Plants robust; leaves usually strongly serrate above	20.
20.	Leaves with a slender strongly serrate apex, strongly falcate-secund (except vars.) never undulate	*20. scoparium.*
	Leaves laxly spreading, rarely secund (except var. *alatum*), sometimes slightly undulate, with broad, often obtuse, apex	**21. Bonjeani.*
21.	Dioicous; leaves narrowly obtuse; capsules not strumose	*16. laevidens.*
	Monoicous; leaves slenderly acute; capsules strumose	*17. arcticum.*

1. DICRANUM MONTANUM Hedw. Sp. Musc. 143. 1801.

Plants *light yellowish-green;* stems usually about 1 cm. long, reported as occasionally reaching 4 cm.; *leaves strongly crisped when dry*, rarely, if ever, secund, erect-spreading when moist, 3–4 mm. long, narrowly long-lanceolate, concave below and channeled above, serrulate or crenulate about 1/3 down on the margins and back of costa; costa percurrent or shortly excurrent, *at base about 1/5 the width of the leaf;* cells in the upper ½ of the leaf quadrate to short rectangular and more or less papilllose, often strongly so, 10–12 μ wide; basal cells elongate-rectangular, near the costa sometimes reaching 10 : 1, *the alar moderately enlarged and inflated*, sometimes colored, none of the cell walls pitted; inner perichaetial leaves rather loosely convolute-sheathing, more abruptly narrowed to a linear rough portion about as long as the base. Seta erect, up to about 1.5 cm. long; capsule oblong-cylindric, erect and symmetric or nearly so, somewhat furrowed irregularly when dry and empty; urn 2–2.5 mm. long; operculum long-conic, about 2/3 the length of the urn; annulus narrow; peristome teeth red, usually divided more than ½ the way down, vertically striate on the outside and faintly papillose; spores 14–18 μ in diameter, nearly smooth, mature late summer to early autumn. Type locality, Germany.

ILLUSTRATIONS:—Hedw. l. c. *pl. 35, figs. 8–13;* Bry. Eur. *pl. 67;* Jennings, Mosses W. Pa. *pl. 8; Pl. 44.*

EXSICCATI:—Drumm. Musc. Am. 102; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 55, (Ed. 2) 71; Aust. Musc. Appal. 81; R. & C. Musc. Am. Sept. 357; Macoun, Can. Musci 34; Holz. Musc. Acro. Bor. Am. 389, 506, both depauperate; Grout, Musci Perf. 115; Bartram Mosses of S. Arizona 52.

On stones, logs and roots of trees, mostly sterile except in the mountains; Newfoundland to Tennessee; West to Arizona and Manitoba; more abundant east of the Mississippi; common in the mountains of New England but fruiting sparingly.

2. DICRANUM FLAGELLARE Hedw. Stirp. Crypt. **3**: 1. *pl. 1.* 1791; Sp. Musc. 130. 1801.

Dicranum miquelonense R. & C. Bot. Gaz. **14**: 93. 1889.
Dicranum crispatulum Kindb. Eur. & N. Am. Bryin. 189. 1897.

Plants in close dark- to pale-green tufts, bearing more or less abundant slender deciduous flagelliform branches from the axils of the upper leaves, these covered with minute scale-like ecostate leaves; stems

* Sterile *D. rhabdocarpum* will be sought here.

about 1 cm. or more in length; leaves 3–4 mm. long, crispate when dry and more or less secund, gradually lanceolate from an oblong base, subtubulose above by the strongly incurved margins, often nearly touching each other, nearly entire except near the apex; costa 1/7–1/5 the width of the leaf base, nearly or quite percurrent into the broadly acute apex, rough on the back above; alar cells well differentiated and usually inflated and brownish, reaching nearly to the costa; lower leaf cells rectangular, 2–8 : 1, with slightly thickened, not pitted walls, the upper shorter 1–3 : 1, all smooth; inner perichaetial leaves from a sheathing base abruptly narrowed to a narrow subula shorter than the sheathing base. Seta 1–2 cm. long; capsule cylindric, erect and symmetric or nearly so, 2–3 mm. long, slightly wrinkled when dry and empty; operculum long-rostrate, more than ½ the length of the urn; annulus narrow; peristome teeth reddish and longitudinally striate below, pale and faintly papillose above, divided at least 2/3 the way down; spores about 15 μ in diameter, slightly roughened, mature in late summer. Type locality, Germany.

Illustrations:—Hedw. l. c.; Bry. Eur. *pl. 68;* M. H. M. *f. 46;* Jennings, Mosses W. Pa. *pl. 8;* Braithw. Brit. Moss Fl. **1**: *pl. 23C; Pl. 44.*

Exsiccati:—Sull. Musc. Allegh. 162; Aust. Musc. Appal. 82; Sull. & Lesq. Musc. Bor. Am. (Ed. 56); Grout, Musci Perf. 141; Holz. Musc. Acro. Bor. Am. 103.

Mostly on rotten wood and peaty banks; Nova Scotia to British Columbia; south to South Carolina and Mexico. Common in the northeastern U. S. and eastern Canada.

The leaf shape varies greatly, in well developed specimens the leaves are longly and narrowly acuminate with little but costa in the upper part and when dry are crispate-falcate; in other specimens the leaves become shorter and broader at apex, 1–2 mm. long and only contorted when dry, grading into

2a. Var. minutissimum Grout, M. H. M. 105. *f. 47.* 1904.

Stems only a few mm. long, growing in dense wide velvety mats over stems and peaty banks in swamps; leaves ovate-lanceolate to triangular-lanceolate, scarcely more than 1 mm. long. Type locality, Lawrence, Long Island, N. Y. Type in herb. A. J. G. M. H. M. *f. 47.*

Of the three common species of *Orthodicranum*, *fulvum* is readily identified by the falcate-secund leaves, dark color and broad costa; *flagellare* by the usually present flagella and smooth tubulose leaves, which may be somewhat crisped and falcate when dry or merely contorted, color lighter than *fulvum* and darker than *montanum; montanum* by the light color and strongly crisped leaves, more papillose at back.

"The specimens called *D. miquelonense* Ren. & Card. are about the same as the European variety growing on rock and called *D. flagellare arenaceum* (Bryotheca Silesiaca *156c*). They are similar also to specimens collected in fruit by Austin at Closter, which have flagella almost wanting. These varieties all differ in having mostly shorter, smoother, rather straighter leaves, and flagella wanting." R. S. Williams, N. Am. Flora **15**^{2}: 120.

3. Dicranum fulvum Hook. Musci Exot. *pl. 149.* 1820.

Dicranum interruptum Bry. Eur. fasc. 37–40. *pl. 69.* 1847.
Dicranum subfulvum R. & C. Bot. Gaz. **22**: 2. 1896.
Dicranum subsubulifolium Kindb. Rev. Bryol. **37**: 13. 1900.

Archegonial plants *fulvous to brownish-green*, often in extensive mats; stems tomentose, up to 5 cm. long; stem leaves 5–6 mm. long, falcate-secund, occasionally somewhat crisped when dry, long-lanceolate, gradually narrowed to a channelled linear point, for the most part slightly serrulate and somewhat papillose roughened near the apex; costa 1/3 or more of the width of the leaf base, excurrent and occupying most of the upper part of the leaf; median and upper leaf cells quadrate to short-rectangular, rarely over 2 : 1, rather incrassate and obscure, about 6 μ wide, bistratose and often lightly papillose on the back in the upper 1/3; lower cells larger and elongate-rectangular except at the margin, not porose; alar cells differentiated, inflated and reaching to the costa; inner perichaetial leaves convolute at base, abruptly narrowed to a linear subula, the innermost sometimes truncate without subula. ♂ plants more slender, mixed with the ♀, bearing a number of rather large scattered ♂ buds; seta solitary, 1–2 cm. long; capsule erect and symmetric or nearly so, cylindric, more or less furrowed when dry and empty; urn up to 4 mm. long; annulus narrow; operculum rostrate ½–⅔ the length of the urn; peristome teeth rather faintly papillose and striate, sometimes almost smooth; spores finely and closely papillose, up to 25 μ in diameter, mature in autumn. Type locality, Nova Scotia.

Illustrations:—Hook. l. c.; Bry. Eur. *pl. 69;* Jennings, Mosses W. Pa. *pl. 9;* M. H. M. *f. 46.*
Exsiccati:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 57, (Ed. 2) 73; Sull. Musc. Allegh. 159; Macoun, Can. Musci 37; Holz. Musc. Acro. Bor. Am. 104; Grout, Musci Perf. 21; Aust. Musc. Appal. 73; Drumm.?
On rocks in cool shaded places; Nova Scotia to Georgia, west to Minnesota and Missouri; common in the mountains of New England and N. Y.
The capsules are smooth until empty and then irregularly furrowed and shrunken; young or depauperate plants often have the leaves very rough above.

3a Var. viride (Sull. & Lesq.) **n. comb.**

Campylopus viridis Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 72. 1856.
Dicranum viride Lindb. Hedwigia **2**: 70. 1863.

Usually growing on wood with the tips of all leaves, except the young upper, broken off; when present the apices are nearly entire and little or not at all papillose at back, often producing protonema from the broken end. The plants are usually smaller than the general run of *fulvum* and the leaves are scarcely secund. Williams (N. Am. Flora **15**[2]: 119) says "Examination of the type collection of *D. viride*, Musci Bor. Am. 72, shows leaves often quite as rough above as *D. fulvum*. Examination of a cross section of the costa of Holzinger's 388 shows no difference from that of *D. fulvum*." M. H. M. *f. 48.*

Exsiccati:—Holz. Musc. Acro. Bor. Am. 388. His no. 8 is nearer the typical form; Aust. Musc. Appal. 73. [See under *D. fragilifolium* p. 84, also Dixon, Handb. Brit. Mosses (Ed. 3) 117.]

4. Dicranum strictum Schleich. Crypt. Helv., Cent. 3. no. 26. 1806: Schwaegr. Suppl. **1**[1]: 188. *pl. 43.* 1811.

Plants in compact cushions, green to yellowish-green; stems 1–5 cm. long, tomentose below, fragile; leaves erect or slightly spreading, *nearly or quite straight when dry*, up to 7 mm. long but usually shorter, *very fragile with the upper portion usually broken off*, from a narrowly lanceolate base gradually narrowed to a slender, canaliculate-subulate upper portion, usually entire but sometimes serrulate towards the apex; costa narrow, 1/7–1/5 the width of the leaf base, long-excurrent, smooth, *without sterei dbands;* alar cells distinctly inflated, hyaline or colored, rarely reaching the costa; other basal cells elongate-rectangular to linear, 4–8 : 1, with rather thin, occasionally pitted walls; other cells gradually shorter upwards, about 2 : 1, rarely quite quadrate in the upper lamina, angular and smooth; perichaetial leaves from a convolute-sheathing base gradually narrowed to a long slender subula, which is usually entire. Setae solitary, reddish-yellow, up to 2 cm. long; capsule erect and symmetric or nearly so, oblong-cylindric, up to 3 mm. long, smooth when dry and empty; operculum long-rostrate, a little shorter than the urn; *annulus* lacking; peristome teeth somewhat irregularly divided at least ½ the way down, nearly smooth on the outer plates below, obliquely striate and papillose above; spores about 16 μ, mature in summer. Type locality, Switzerland.

Illustrations:—Schwaegr. l. c.; Bry. Eur. *pl. 66. Pl. 44.*
Exsiccati:—Macoun, Can. Musci 34a; Holz. Musc. Acro. Bor. Am. 635, 32 (as *D. fragilifolium*). R. & C. Musc. Am. Sept. 273; Grout, Musci Perf. 131; Allen, Mosses Cascade Mts. 7; Howe, Musci Calif; 108.*
On decaying wood, rarely on rocks or soil; from Alaska southwards to California, Idaho and Wyoming. Frequent within its range and apparently fruiting freely. (See note under *D. fragilifolium* concerning sterile plants.)

5. Dicranum rhabdocarpum Sull. Mem. Am. Acad. **5**[2]: 172. *pl. 3.* 1849.

Dicranum scoparioides Schimp.; Besch. Mém. Soc. Nat. Cherb. **16**: 164. 1872.

♂ plants in more or less separate tufts, more slender than the ♀; ♀ plants in compact tufts, stems branching, densely radiculose below, 2–4 cm. long; leaves erect-spreading, *secund at apex of stems only, not at all crispate when dry;* stem leaves 3–5 mm. long, ovate-lanceolate, serrulate on the margins in the upper part, narrowly to broadly acute, concave below and tubulose above; *costa vanishing below the apex, 60 μ or less in width at the base,* toothed on the back above; alar cells differentiated, from moderately to greatly inflated, hyaline or golden-brown, rarely extending to the costa, the cells immediately above elongated-rectangular, wider than those near the costa, *above these the cells are elongated* and *pitted nearly to the apex,*

* In Howe's 108 the peristome teeth are striate to the base; in Holzinger's 635 the teeth are split and perforate to the base.

the median linear-oblong, about 8–12 μ wide, 40–60 μ long, shorter near the apex and more irregular; perichaetial leaves sheathing at base, *rather abruptly narrowed to a nearly smooth slender point,* ½ the length of the base or less; seta 1.5–2.25 μ long, *orange-yellow, becoming dark red with age;* capsule 3–3.5 mm. long, cylindric, erect and symmetric, or sometimes slightly curved, strongly furrowed when dry; *annulus lacking;* operculum long-rostrate, more than ½ the length of the capsule; peristome teeth reddish-brown, vertically striate on the outside, divided or perforate up to ¾ the length, rough with papillae and irregular ridges at the tips; spores up to 18 μ in diameter, mature in autumn. Type locality, Colorado.

ILLUSTRATIONS:—Sull. l. c.; *Pl. 46.*

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 82; Baker, plants of Colorado 110; Bartram, Mosses of S. Arizona 42; Clements, Crypt. From Colo. 196; Holz. Musc. Acro. Bor. Am. 507.

On soil, rocks, and wood, 8,000–10,000 ft., Colorado, New Mexico and Arizona; also in Mexico.

Sterile plants are likely to be mistaken for *D. Bonjeani,* but the leaves are usually acute at apex and the species appears to be exclusively of the Rocky Mts. and their southern extension. The elongated and pitted upper leaf cells distinguish it from all our other *Orthodicrana* and seem to indicate a close relationship to the *scoparium* group of *Eudicrana.*

6. DICRANUM FUSCESCENS Turn. Musc. Hib. 60. 1804.

Dicranum congestum Brid. Musc. Recent. Suppl. **1**: 176. 1806.
Dicranum sulcatum Kindb.; Macoun, Bull. Torr. Club. **17**: 87. 1890.
Dicranum crispulum C. M. & Kindb.; Macoun, Cat. Can. Pl. **6**: 27. 1892.
Dicranum leucobase C. M. & Kindb. l. c. 30. 1892.
Dicranum trachyphyllum R. & C. Bot. Gaz. **22**: 48. 1896.
Dicranum camptophyllum Kindb. Eur. & N. Am. Bryin. 193. 1897.

♂ plants mingled with the ♀ and nearly as large, both in soft dull- to yellowish-green sods; stems 2–8 cm. long, tomentose below; stem leaves more or less falcate-secund, crisped when dry, especially the upper ones, up to 7 mm. long, from a broadly lanceolate base gradually narrowed to a long slender, flexuous grooved or subtubular upper portion; upper margin from nearly entire to strongly toothed, more or less incurved, sometimes bistratose; costa ⅙–¼ the width of the leaf at base, excurrent, toothed on the back above; alar cells larger and inflated, usually brown; cells above these rectangular, 8–10 μ wide by 40–80 μ long with pitted or unpitted walls; upper leaf cells 6–7 μ wide, quadrate, rectangular or irregular with sharp angles, walls not pitted, smooth to spinose-papillose on the back; perichaetial leaves convolute at base, the inner abruptly narrowed to a slender costate subula denticulate at apex. Seta solitary, yellowish, 1.5–2 cm. long; capsule brown to yellow, oblong to cylindric, inclined, unsymmetric to arcuate, 2–3 mm. long, furrowed when dry; operculum long-rostrate, often nearly as long as the urn; annulus narrow; peristome teeth red, vertically striate, split about half way; spores about 18–24 μ in diameter, mature in autumn. Type locality, Scotland.

ILLUSTRATIONS:—Braithw. Brit. Moss. Fl. **1**: *pl. 22D;* M. H. M. figs. *42, 44; pl. 46.*

EXSICCATI:—Drumm. Musc. Am. 82; Sull. Musc. Allegh. 157, 158; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 157, 158, (Ed. 2) 64, 80; Aust. Musc. Appal. Suppl. 472; R. & C. Musc. Am. Sept. 8; Grout, Musci Perf. 40; Holz. Musc. Acro. Bor. Am. 33, 486, 653; Allen, Mosses Cascade Mts. 9; Baker, Pacific Coast Bryophytes 585, 587.

On decayed wood, soil and bases of trees in cool moist woods in mountain regions; Labrador to S. Carolina, west to Alaska and California; common in mountains of N. England and N. Y.

Dixon, Handbk. Brit. Mosses 114, says of this species "A very difficult and variable species; the leaves may be smooth or highly papillose, entire at margin or closely denticulate; the fruit varies in color, in the amount of striation, in direction, and in form from broadly ovate to narrowly cylindric."

6a. Var. CONGESTUM (Brid.) Husnot. Musc. Gall. 34. 1884.

Dicranum congestum Brid. Sp. Musc. **1**: 176. 1806.

Leaves broader, more shortly pointed, faintly or not at all papillose at back; costa narrower, 1/6–1/9 width of leaf base, percurrent to shortly excurrent; upper leaf cells longer, larger, sinuosely elliptic-rhomboid.

Holzinger's 610, issued as *D. congestum,* I cannot differentiate from *fuscescens,* but specimens collected by me in and around Tolland, Colorado in 1914 and a specimen in Canadian National Museum, Macoun,

Kicking Horse Lake as *D. algidum subspadiceum* Kindb. seem to be enough different to place in this variety, which probably occurs elsewhere in the Rocky Mts.

The *D. fuscescens* of the Rocky Mts. and westward seems to be larger than that from the eastern U. S., also to have the leaves more strongly falcate-secund and less crispate.

7. Dicranum Muhlenbeckii Bry. Eur. fasc. 37–40. *pl. 78.* 1847.

Dicranum Rauei Aust. Bot. Gaz. **1**: 28. 1876.

Subspecies of *D. fuscescens*, with which it is compared below. Plants larger on the average, growing *in dense tomentose sods;* leaves *erect and nearly equally spreading when moist, more or less crisped when dry*, 4–6 mm. long, subtubulose above by the inrolled margins, serrate to nearly entire above, apex broader, acute; costa percurrent to slightly excurrent, at least 1/6 width of leaf base; basal cells above the inflated alar rectangular, averaging shorter but not always shorter in any two given specimens (one from each species) somewhat porose; upper cells more irregular, quadrate, triangular, rhomboidal, rectangular, etc., not porose 10–12 μ wide; perichaetial leaves with shorter subula. Capsule cylindric, up to 4 mm. long, somewhat arcuate, typically almost erect and much less striate, 4–6 : 1; spores summer to autumn. Type locality, European.

Illustrations:—Bry. Eur. l. c.; M. H. M. *pl. 16.*

Exsiccati:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 65, (Ed. 2) 81; Grout, Musci Perf. 259 (as *D. fuscescens*).

Typical plants as described above are very distinct from the ordinary run of *D. fuscescens*, but there are all sorts of intergrading forms, some of which are almost impossible to place accurately.

On rocks and soil, occasionally on decaying wood; New England and Ontario to Alaska; south to New Jersey and New Mexico. Alpine and depauperate forms grade into

7a. Var. brevifolium Lindb. Bot. Not. **1865**: 80. 1865.

Leaves shorter and broader in apical region, incurved to strongly crisped; lower leaf cells narrower, up to 12 μ wide at most; capsules 2.5–3 : 1. Alaska to British Columbia. Holz. Musc. Acro. Bor. Am. 560, from Pikes Peak, Colorado is near this variety, but the lower leaf cells are too wide to be typical.

Easy to confuse with *D. condensatum* and its thicker costa and less xerophytic habitat seem the best means of distinction in critical cases, especially of sterile plants. The difference in size of leaf cells as described by Limpricht and Williams does not seem to hold.

I cannot follow Williams in his treatment of *D. brevifolium* in N. Am. Flora **15**[2]: 124. I have examined the specimens he has named *brevifolium* in the herbarium of The New York Botanical Garden and he seems to have transferred to *brevifolium* most of the plants previously named *Muhlenbeckii*.

8. Dicranum Bergeri Bland. Musci Frond. Exs. no. 114. 1805; Bot. Zeit. Regensb. **5**: 52. 1806.

Dicranum Schraderi Web. & Mohr. Bot. Tasch. 177. 1807.
Dicranum stenodictyon Kindb.; Macoun, Bull. Torr. Club. **16**: 92. 1889.
Dicranum rugosum Kindb. Ottawa Nat. **4**: 61. 1890.
Dicranum undulatum Schrad. Spic. Fl. Germ. 59. 1794 & Brid. Sp. Musc. **1**: 76. 1806. (not of Ehrh.).

Plants in deep dense sods, dull- to yellowish-green; stems tomentose, up to 15 cm. in length; leaves crowded, erect to slightly spreading, hardly secund, little changed in drying, but somewhat flexuose; 6–7 mm. long, from an oblong or lanceolate base gradually narrowed to the wavy channelled slender point, base slightly wider just above the insertion, typically rounded-obtuse at the apex, but sometimes obtusely acute, more or less serrulate above, typically smooth at the back above but sometimes with a few small teeth, or large papillae; costa typically ending below the apex, but sometimes percurrent in some of the leaves; costa rather narrow, toothed above on the back, rarely nearly smooth; alar cells colored and inflated; lower leaf cells thick-walled and pitted, linear, about 8 μ wide, 60–80 μ long; upper cells shorter, 1–3 : 1, irregular (quadrate, triangular, rounded-rectangular), usually a few longer near the apex; inner perichaetial leaves shorter, from a convolute-sheathing base abruptly narrowed to a slender subula. ♂ plants minute, attached to the tomentum of the ♀; seta solitary, pale, yellowish to orange, 3–4 cm. long; capsules arcuate-cylindric, cernuous, lightly striate when dry and empty; urn 2.5–3.5 mm. long, not strumose; operculum

long-rostrate, annulus of 2–3 rows of cells; peristome teeth somewhat irregularly divided into two, sometimes 3 or even 4 prongs, strongly papillose throughout, lightly striate below; spores slightly rough, 15–21 μ in diameter, mature in summer. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 80;* Braithw. Brit. Moss. Fl. **1**: *pl. 22B;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 14B; Pl. 46.*

EXSICCATI:—Drumm. Musc. Am. 87, 88; Sull. Musc. Allegh. 163; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 67, (Ed. 2) 84; Aust. Musc. Appal. 93; R. & C. Musc. Am. Sept. 12; Holz. Musc. Acro. Bor. Am. 533, a poor depauperate form. His 130 is, I think, *D. Drummondii.* Austin's 93 & 94 approach *Drummondii.*

In bogs and meadows in cold situations, largely alpine and arctic; Labrador to Alaska, southwards to New Jersey, Ohio and Colorado.

This species seems to grade into *D. Drummondii,* especially forms with acute leaves and percurrent or short-excurrent costa. For distinctions see that species.

The pitting of the walls of the basal cells varies a great deal even in the same plant. Apparently it is greatest in the older leaves, but more apparent in *Bergeri* than in *Drummondii.*

9. DICRANUM DRUMMONDII C. Muell. Syn. **1**: 356. 1848.

Dicranum undulatum var. Hook. in Drumm. Musc. Am. 86. 1828.

Differs from *D. Bergeri* as follows; leaves reaching 9 mm. long, narrowly acute, spreading-flexuous when moist, more or less secund and crispate when dry, more strongly serrate above; leaf blade and costa more strongly roughened on the back above; basal leaf cells less pitted; costa papillose on the back to nearly the middle, percurrent or excurrent. Setae usually aggregate, 1–4 from a single perichaetium. Type locality, North America.

ILLUSTRATIONS:—Sull. Icones Musc. Suppl. *pl. 33; Pl. 48, 50.*

EXSICCATI:—Drumm. l. c.; Sull., & Lesq. Musc. Bor. Am. (Ed. 1) 69b, (Ed. 2) 88; Holz. Musc. Acro. Bor. Am. 131, 130 (as *D. Bergeri*), 432; Aust. Musc. Appal. Suppl. 474.

On soil in cool shaded moist places; Maine to Manitoba and Montana; south to New Jersey and Colorado.

When in good fruit the clustered capsules are distinctive, but often only single and solitary capsules are found; when dry the crispate leaves distinguish from *Bergeri,* but when moist this distinction is not obvious; the rougher and more slender pointed leaves will usually serve for identification. There are cases, particularly in the case of poorly developed plants, that can hardly be distinguished.

Williams, N. Am. Flora 15^2: 122 compares this with the European *D. elatum* Lindb. *D. rugosum* is distinguished by the more strongly undulate non-crisped leaves and the elongated porose upper leaf cells.

The more slender undulate leaves and darker color distinguish from *D. fuscescens* var. *congestum,* which is found in more xerophytic conditions. The pitting of the walls of the basal cells varies a great deal even on the same plant, and is apparently greater in the older leaves, but in general less developed in *D. Drummondii* than in *D. Bergeri.*

10. DICRANUM CONDENSATUM Hedw. Sp. Musc. 139. *pl. 34.* 1801.*

Dicranum pallidum Bry. Eur. fasc. 37–40. 1847, not of Web. & Mohr, 1807.
Dicranum spurium condensatum Lesq. & James Man. 76. 1884.
Dicranum sabuletorum R. & C. Bot. Gaz. **14**: 91. *pl. 12A.* 1889.

Plants in compact radiculose sods, green to yellow-green; stems about 2 cm. long rarely up to 4 cm.; leaves erect-spreading when moist, and scarcely secund and nearly straight, when dry more or less flexuose to crispate, sometimes undulate, oblong-lanceolate, gradually narrowed to a channelled acute apex, 4–6 x 0.75–1 mm., smooth or somewhat papillose at back above; costa 80–100 μ wide, 1/8–1/10 width of leaf at base, percurrent to slightly excurrent, sometimes nearly smooth at back but usually toothed and more or less papillose, in cross section with 7 or 8 median guide cells with well developed stereid bands above and below; upper leaf cells short, angular, irregular, 1–1.5 : 1, averaging about 8 μ wide near the middle; the lower linear to elongate-rectangular, with walls more or less pitted; alar cells inflated, usually golden-brown; perichaetial leaves shorter, from a broad convolute-sheathing base abruptly narrowed to a slender, linear, smooth or denticulate subula. ♂ plants attached to the tomentum of the ♀; seta solitary, yellow, 2–3 cm. long; capsule pale, 2 mm. or less long, oblong to short-cylindric, unsymmetric to arcuate, inclined to cernuous, sometimes slightly strumose, somewhat furrowed when dry; operculum obliquely long-rostrate; annulus distinct; peristome teeth dark-reddish, usually divided more than ½ the way down into 2–3 prongs, longi-

* See Williams' note in N. American Flora 15^2: 123.

tudinally striate on the outer face, papillose above; spores slightly rough, up to 22 μ, mature in spring. Type locality, Lancaster, Pennsylvania.

ILLUSTRATIONS:—Hedw. l. c.; Bot. Gaz. l. c.; M. H. M. 103, *f. 45*.
EXSICCATI:—Sull. Musc. Allegh. 160; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 68, 68b, (Ed. 2)85, 86; Holz. Musc. Acro. Bor. Am. 54.
On dry sandy soil, Nova Scotia to Florida; west to Wisconsin, Missouri, and Texas; very common in the New Jersey Pine Barrens. Distinguished from *D. Muhlenbergii* by the characters noted in the key and from *D. spurium* in the narrower, scarcely undulate leaves, much less strongly papillose above on the back.

11. DICRANUM SPURIUM Hedw. Sp. Musc. 141. 1801; Stirp. Crypt. **2**: 82. *pl. 30*. 1789.

Dicranum brachycaulon Kindb.; Macoun, Cat. Can. Pl. **6**: 34. 1892.

Plants robust, 2–4 cm. high, rarely more, yellowish-green, loosley tufted, mostly interruptedly foliate; leaves loosely imbricate, up to 6.5 mm. long, incurved and crispate in the upper portion when dry, strongly rugose-undulate, subtubulose above, ovate to ovate-lanceolate below, *notably widest some distance above the base*, rapidly narrowed to the narrowly lanceolate upper portion, broadly acute, serrate above on the margin and back of costa, densely papillose on the back about ½ the way down; costa rather narrow, 1/7–1/10 the leaf width at the broadest part, nearly percurrent; alar cells inflated, hyaline or colored, often bi-tri-stratose; lower leaf cells elongated-rectangular to linear, with porose walls, soon changing to the irregular angular upper cells which are triangular, quadrate, or even transversely elongate, 8–10 μ wide with thick irregular, non-pitted walls, the marginal more elongate; perichaetial leaves broadly convolute-sheathing at base, abruptly narrowed to a rather short, linear, nearly smooth upper portion. Antheridial plants minute, often scarcely 1 mm. high, attached to the tomentum of the female plants; setae slender, solitary, yellowish to red, 2–3 cm. long; capsule light colored, subcylindric, arcuate and inclined, irregularly sulcate and contracted under the mouth when dry and empty, about 2 mm. long, often somewhat strumose; operculum obliquely rostrate, about as long as the urn; peristome teeth red, vertically striate, divided about ½ the way into 2 or 3 prongs; annulus distinct; spores somewhat rough, up to 20 μ in diameter, mature in spring. Type locality, Germany.

ILLUSTRATIONS:—Hedw. l. c.; Bry. Eur. *pl. 81;* M. H. M., *f. 45; pl. 46*.
EXSICCATI:—Drumm. Musc. Am. 90, Musc. Am. S. States 47; Aust. Musc. Appal. 95; Holz. Musc. Acro. Bor. Am. 228, 228b.
On rather dry sandy soil or rocks in shaded places, rather infrequent and fruiting rather infrequently; Newfoundland to the Lake Superior Region, south to Tennessee and Missouri.
Distinct from the related species by the thickly papillose back of the upper portion of the leaves.

12. DICRANUM FRAGILIFOLIUM Lindb. Oefv. Sv. Vet.-Akad, Förh. **14**: 125. 1857.

Plants slender, in compact green sods; stems 1–13 cm. long, tomentose; leaves erect-open when moist, when dry more erect, nearly straight, with brittle points mostly broken, narrowly lanceolate, 6–7 mm. long, gradually narrowed to a long slender apex, usually entire but occasionally serrulate above and less attenuate, the channelled upper portion consisting chiefly of the excurrent costa, which is ¼–⅓ the width of the lower part of the leaf and nearly or quite smooth in the excurrent portion; inflated alar cells brown or hyaline, usually extending to the costa; lower leaf cells elongate, mostly rectangular, sometimes pitted, becoming increasingly shorter above, not pitted, thick-walled and rounded, in the upper lamina 1–2 : 1, about 8 μ wide; perichaetial leaves from a broad convolute-sheathing base abruptly narrowed to a slender, nearly smooth point about as long as the clasping base. Male plants slender, in the tomentum of the upper fertile stems, up to 6 mm. long; seta 1.5–2 cm. long, yellow, turning reddish with age; capsule about 2 mm. long, oblong to ovoid, curved and inclined, furrowed when dry, not strumose; annulus distinct; operculum conic-rostrate, about the length of the urn; peristome teeth brownish-red, longitudinally striate; spores up to 25 μ, ripe in summer. Type locality, Sweden. *Pl. 47*.

EXSICCATI:—Macoun, Can. Musci 22a.
On decaying wood; Labrador to Alaska, south to Minnesota,* Montana, Washington and Oregon.
Rarely fruiting and probably reproducing by the broken leaf tips.
Sterile plants distinguished from *D. strictum* by the broader costa, alar cells reaching costa in most cases and upper cells shorter, thicker-walled and more rounded at the ends. *D. fulvum viride* is distinguished

* The Minnesota plants collected by Holzinger and determined by Bryhn, have leaves serrulate near the apex and costa shortly excurrent; they are doubtfully this species.

from both by the shorter quadrate upper leaf cells. Brotherus (Laubm. Fennoskand. 96) states that the costa in this species has no stereid bands; Williams (N. Am. Flora **15**^{2}: 126) states that it has one on each side of the guides.

13. DICRANUM ELONGATUM Schleich.; Schwaegr. Suppl. **1**^{1}: 171. 1811.

Dicranum sphagni Wahlenb. Fl. Lapp. 337. 1812.
Ducranum subflagellare Card. & Thér. Proc. Wash. Acad. Sci. **4**: 298. 1902.

Plants in dense compact sods; stems up to 15 cm. long, tomentose, slender; leaves erect-appressed to incurved when dry, the uppermost sometimes contorted, 3–4 mm. long, from a lanceolate base gradually narrowed to a subtubulose or channelled acute point, entire or slightly serrulate at apex; costa 1/6–1/4 the width of the leaf at a point a little above the base, percurrent to shortly excurrent; alar cells usually colored; lower cells elongate, linear, incrassate, more or less pitted near the base, becoming shorter 1–2 : 1, rounded, and not pitted in the upper lamina. Seta about 1.5 cm. long; capsule small, about 1.5 mm. long, slightly inclined and curved, somewhat furrowed when dry; annulus well developed, operculum long-rostrate, about as long as the urn; peristome teeth dark-red, longitudinally striate; spores up to 24 μ, mature in late summer. Type locality, France.

ILLUSTRATIONS:—Braithw. Brit. Moss Fl. **1**: *pl. 23A;* Dixon, Handb. Brit. Mosses *pl. 15A; Pl. 44 & 48.*
EXSICCATI:—Drumm. Musc. Am. 91, 92; R. & C. Musc. Am. Sept. 91, 92; Holz. Musc. Acro. Bor. Am. 559, 633.
On rocks and soil; Greenland to Alaska; south to the mountains of Montana and New England.
D. sphagni is regarded by Brotherus as a variety.
The small capsules (2 mm. long or less) of the arctic-alpine species *fragilifolium, laevidens, elongatum* and *groenlandicum* when present, set them off from the related species.

14. DICRANUM SPADICEUM Zett. Musc. Pyren. 30. 1864, and K. Sv. Vet.-Akad. Handl. **5**: 20. 1865.

Dicranum neglectum Jur.; Milde in Beilage Bot. Zeit. 1864 and Laubm. 47. 1882.
Dicranum algidum Kindb. Rev. Bryol. **23**: 17. 1896 (*fide* Williams).

Plants in compact dark-green sods, sparingly tomentose, 4–5 cm. high; stem leaves erect-spreading, when dry laxly appressed and often somewhat contorted, 3.5–5 mm. long, from a broadly lanceolate base gradually narrowed to a tubulose subulate upper portion, usually smooth, sometimes slightly toothed on the margins and somewhat rough on the back; costa percurrent or slightly excurrent, smooth or somewhat roughened at the apex, *about 1/9 the width of the leaf at the broadest part;* alar cells well differentiated and inflated, usually colored, not extending quite to the costa; cells of the lower leaf much as in *scoparium;* the upper becoming as broad as long in part, very irregular and rounded, usually not pitted; inner perichaetial leaves from a convolute-clasping base abruptly narrowed to a slender, smoothish point a little shorter than the base. Seta yellowish to orange, 1.5–2 cm. long; capsule 2–2.5 mm. long, arcuate-cylindric, when dry furrowed, not strumose; annulus distinct; peristome teeth vertically striate except when old; spores up to 20 μ, mature in late summer. Type locality, mountains of the southern Tyrol, Austria. *Pl. 47.*

EXSICCATI:—E. & A. Nelson, Plants of Yellowstone National Park 5396.
On wet rocks at high altitudes and latitudes, rare; Alaska south to Oregon, Montana and Wyoming.
Distinguished from *D. elongatum* by the relatively much narrower costa.

15. DICRANUM GROENLANDICUM Brid. Musc. Recent. Suppl. **4**: 68. 1819.

Dicranum labradoricum C. Muell. Syn. **1**: 366. 1848.
Dicranum tenuinerve Zett. Sv. Vet.-Akad. Handl. II. **13**^{13}: 14. 1876.
Dicranum Macounii Aust. Bot. Gaz. **2**: 96. 1877.

Differs from *D. elongatum* in the broader, narrowly *obtuse,* usually smooth and entire leaves with a narrower costa (1/8–1/10 width of leaf base), more strongly tubulose above; *leaf cells pitted to well above the leaf middle.* Capsules nearly erect and symmetric.

ILLUSTRATIONS:—Bry. Eur. *pl. 76* (according to Williams, N. Am. Flora **15**^{2}: 127); *Pl. 47.*
EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 63, 79; R. & C. Musc. Am. Sept. 6, 6b.
In bogs and wet places; circumpolar; south to the mountains of New England; apparently common in the far north. Distinguished from *D. laevidens* by the shorter leaf cells of the upper lamina, the more erect capsules and more strongly striate peristome teeth.

16. Dicranum laevidens Williams, N. Am. Flora 15²: 126. 1913.

Plants in wide compact sods, glossy, brownish-green except at the growing tips; stems 7–8, rarely 15 cm. long, rather slender, tomentose; leaves little changed in drying, nearly straight, erect spreading in all directions, 5–6 x 1 mm. from an ovate-lanceolate base rather gradually narrowed to a nearly tubulose smooth upper portion, with apex typically *narrowly rounded-obtuse with short cells;* costa 1/8–1/10 the width of the leaf base, ending in or below the leaf apex, smooth throughout, in a median cross-section with 5 or 6 guide cells and a stereid band of one or two rows of cells above and below; inflated alar cells reaching nearly to the costa, other cells elongate almost to the apex, the median sublinear with strongly pitted walls, 8–10 x 40–60 μ, the upper much shorter and less pitted, 2–4 : 1; inner perichaetial leaves scarcely as long as the stem leaves, convolute-clasping at base, rather abruptly narrowed to a linear entire subula up to 2 mm. long; seta yellowish to reddish, 2.5–3 cm. long; capsule oblong, inclined, slightly curved and unsymmetric, about 2 mm. long, furrowed when dry, not strumose; annulus large; operculum long-rostrate, with an oblique beak about the length of the urn; peristome teeth reddish, divided (sometimes irregularly so) more than ½ the way down "neither distinctly vertically striate nor papillose;" calyptra 4 mm. long, smooth; spores 20–24 μ in diameter, mature in summer. Type collected on the Klondike River near the mouth of Bonanza Creek, 3 miles from Dawson, Yukon, July 23, 1899 (Williams 539). Type in herb. N. Y. Botanical Garden, seen and studied. *Pl. 47.*

In wet swampy places, Dawson; Quinhagak, Alaska (Stecker); Hudson Bay (Comer); N. W. Greenland (Hovey).

The striking thing about the leaf structure is the blunt entire apex with short cells like those in the apex of *Leptodictyum riparium obtusum.* Much the same sort of apex is found in the narrower leaves of *D. groenlandicum,* but in that species all the leaf cells of the narrower leaves are much more incrassate. In a peristome from the type material the middle plates of the teeth were plainly striate on the outside and the points of the prongs papillose. Occasional plants of *D. scoparium* and *D. Bonjeani* have similar, but wider, leaf apices on the upper portion of the new shoots, but in these the lower leaves are normal. *D. augustum* Lindb. Meddel. Soc. Fl. Fenn. 252. 1881, has narrower-pointed, acute leaves, more or less toothed at the apex. It is very doubtfully American, though *D. laevidens* might possibly better be regarded as a variety of *D. angustum* with blunt leaves, smooth and entire at apex, and with teeth little striate. *D. laevidens* is distinguished from *D. groenlandicum* by the much more elongated upper leaf cells. Williams' Lake Lindeman plants referred to *laevidens* are very close to *angustum.* (See *Pl. 48.*)

17. Dicranum arcticum Schimp. Bry. Eur. Suppl. Fasc. 3–4. *pl. 3.* 1866.

Dicranum Starkei var. *molle.* Wilson, Bry. Brit. 74. 1855.
Dicranum glaciale Berggr. Act. Univ. Lund. 2¹: 19. *f. 1–9.* 1866.

Plants in wide deep tufts, 5–12 cm. high, yellowish- to olive-green above, brown below; stems not radiculose except at base, mostly slender and simple; leaves straight, and erect-open or somewhat curved toward the summit of the stem, 4–6 mm. long, subtubulose above, from an ovate- or oblong-lanceolate base gradually narrowed to a slender subulate upper portion, entire or nearly so; costa shortly excurrent, about 1/10 the width of the leaf base, in cross section with the median row of 4–7 guide cells rather less strongly differentiated than in most species; alar cells strongly inflated, not reaching the costa, usually colored; other cells linear, with thick walls more or less pitted in the lower portion, shorter above, the median about 6 x 40–60 μ; perichaetial leaves, from a clasping ovate base abruptly narrowed to a slender nearly smooth point of about an equal length. *Autoicous;* ♂ flower close to the ♀; seta about 1.5 cm. long, rarely longer; capsule about 2 mm. long, oblong-cylindric, inclined and curved, in most cases distinctly striate and strumose when dry; annulus well developed; operculum obliquely rostrate; peristome teeth longitudinally striate below, papillose above; spores about 16 μ, mature in summer. Type locality, Norway.

Illustrations:—Bry. Eur. l. c.; Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 13H; Pl. 43.*

On moist rocks and soil, Greenland, Labrador and the Yukon.

This arctic-alpine species resembles exaggerated *Arctoa Starkei,* and its autoicous inflorescence also indicates a relationship to *Arctoa,* but the large size, presence of guide cells in the costa and the pitted leaf cells ally it with *Eudicranum.* It is obviously an intermediate form, as *D. rhabdocarpum* is a form intermediate between *Orthodicranum* and *Eudicranum.*

18. Dicranum rugosum (Hoffm.) Brid. Sp. Musc. 1: 175. 1806.

Dicranum polysetum (Sw.) Schwaegr. Suppl. 1¹: 165. *pl. 41.* 1811.
Dicranum undulatum (Ehrh.) Sturm, Deutsch. Fl. 2: 10. 1812?.

Plants tall, up to 25 cm. and robust, growing in loose wide mats, densely radiculose, bright glossy yellow-green; *leaves strongly undulate*, long-lanceolate, up to 10 x 1.5 mm., *spinosely serrate in the upper half*, spreading-flexuous, margins slightly recurved below; costa strong but relatively narrow, vanishing in the apex or slightly below, with *two sharply toothed lamellae on the back above;* alar cells distinctly differentiated, colored, scarcely reaching the costa; other leaf cells elongate and porose, median about 12 x 40–60 μ, the upper smaller, all smooth. Setae aggregate, 1–7 in a perichaetium, yellowish or reddish, 2–4 cm. long; capsule arcuate-cylindric, cernuous, 2–3 mm. long, somewhat furrowed and slightly contracted under the mouth when dry and empty, not strumose; annulus lacking; operculum obliquely rostrate, fully as long as the urn; peristome teeth finely striate vertically, deeply divided, sometimes irregularly into 3 prongs, and papillose on the margins and prongs; spores about 18–24 μ, mature in late summer. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 82, 83;* M. H. M. *f. 46;* Mosses w. H.-lens *pl. 21;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 13I; Pl. 43.*

EXSICCATI:—Drumm. Musc. Am. 85; Sull. Musc. Allegh. 156; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 69, (Ed. 2) 87; Aust. Musc. Appal. 97; Holz. Musc. Acro. Bor. Am. 134, 589.

On moist shaded soil in cool places; Newfoundland to British Columbia; south to Oregon, Minnesota, Ohio and W. Virginia.

19. DICRANUM MAJUS Smith, Fl. Brit. 1202. 1804.

Plants like an exaggerated *D. scoparium; leaves very long, up to 15 mm.*, strongly and regularly falcate-secund, scarcely altered when dry, toothed on the margins and back above; costa about 1/12 the width of the leaf base, strongly toothed on the back above but hardly lamellate; *lower leaf cells very incrassate and porose*, lumen hardly twice the thickness of the cell wall. Setae aggregate, 2–5 from a single perichaetium (occasionally single); operculum fully as long as the urn. Type locality, England.

ILLUSTRATIONS:—Braithw. Brit. Moss Fl. **1**: *pl. 20E;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 14F; Pl. 46.*

EXSICCATI:—Macoun, Can. Mosses 35.

In woods; Greenland to Maine and in Alaska.

In fruit, the aggregate setae easily distinguish it from *scoparium*, the non-undulate leaves from *Drummondii* and *rugosum*.

19a. Var. ORTHOPHYLLUM A. Br.; Milde, Bryol. Siles. 71. 1869.

Leaves nearly straight. Holz. Musc. Acro. Bor. Am. 278 from New Brunswick; according to Williams this is frequent in Alaska.

20. DICRANUM SCOPARIUM [L.] Hedw. Sp. Musc. 126. 1801.

Dicranum pallidum C. Muell. Syn. **1**: 359. 1848. (not of Web. & Mohr, 1807.)
Dicranum mexicanum Schimp.; Besch. Mém. Soc. Nat. Cherbourg **16**: 164. 1872.
Dicranum Howelii R. & C. Bot. Gaz. **14**: 93. *pl. 12B.* 1889.
Dicranum angustifolium Kindb.; Macoun, Bull. Torr. Club **17**: 86. 1890.
Dicranum canadense Kindb. l. c. 87. 1890.
Dicranum Kindbergii Paris, Index. Bryol. (Ed. 1) 356. 1895.
Dicranum scopariforme Kindb. Eur. & N. Am. Bryin. 193. 1897.

Plants large, up to 10 cm., in wide glossy yellow-green sods, rather loosely tufted and tomentose; leaves typically strongly falcate-secund, not undulate (with rare exceptions), narrowly lanceolate-subulate, subtubulose above, up to 9 mm. long, strongly serrate above on the long narrow subula, little changed in drying, lamina smooth on the back; costa ending in the apex or shortly excurrent, bearing on the back above 2–4 more or less prominent serrate lamellae or ridges, rarely nearly smooth; leaf cells all elongate and more or less porose, the lower oblong to rectangular, linear at the margin, shorter and less porose above; alar cells inflated and usually colored, rarely extending to the costa; perichaetial leaves sheathing at base, gradually to abruptly narrowed to a long linear subula, which is usually toothed. ♂ plants minute often attached to the tomentum of the ♀ and sometimes appearing as if attached to the stem itself. Setae solitary, yellowish- to reddish-brown, 2.5–3 cm. long; capsule arcuate-cylindric, 3–4 mm. long, brown, inclined, typically smooth but occasionally somewhat furrowed when dry and empty, but not contracted under the mouth; operculum long-rostrate, rather more than ½ the length of the urn; annulus wanting; peristome teeth red-brown, typically striate longitudinally and divided into 2, rarely 3 papillose prongs, at least ½ the way down; spores slightly rough, up to 24 μ, mature late summer to autumn. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 74, 75;* Braithw. Brit. Moss Fl. **1:** *21A;* Jennings, Mosses W. Pa. *pl. 8;* M. H. M. *figs. 42, 43 & 44; Pl. 46.*

EXSICCATI:—Drumm. Musc. Am. 80; Sull. Musc. Allegh. 155; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 59, 60, 61, 62, (Ed. 2) 75, 76, 77, 78; Macoun, Can. Musci 36, 37; Holz. Musc. Acro. Bor. Am. 7. 55, 176, 611; Allen, Mosses Cascade Mts. 8a, 8b (var. *sulcatum*) Grout, Musci Perf. 5.

On soil, rocks and decaying wood in shaded places, very common and almost universal in the temperate Northern Hemisphere.

Exceedingly variable in almost every character, even in plants in the same tuft and leaves on the same plant. Most descriptions describe the costa as not quite percurrent, but in most vigorous specimens the apical lamina is undemonstrable to the author; the leaf cells vary immensely in length and porosity and the leaves at times are almost straight and only slightly toothed at the back. These variations have given rise to the naming of various varieties and subspecies. *D. consobrinum* R. & C. Bot. Gaz. **15:** 39. *pl. 35B* is a form in which the inner perichaetial leaves are emarginate and with subula very short or wanting; the male plants are said to be attached to the female. Some of the perichaetial leaves are as described by the authors, but others from the type collection have normal perichaetial leaves.

In the form described as var. *sulcatum* R. & C. Bot. Gaz. **14:** 92. 1889, the seta is pale yellow and the capsules deeply furrowed when old. *D. Howellii* is a western form with perichaetial leaves gradually narrowed into a long serrate upper portion. In some specimens the basal leaf cells are about 12 x 45–80 μ and strongly porose; upper cells markedly porose and about 3–5 : 1, these seem to be high altitude forms. Other plants have the basal cells 52–105 μ long and sparingly porose; the upper 3–5 : 1 and scarcely porose or pitted. These latter usually have narrower apices than the former.

In some specimens the leaves may be slightly crisped, in others almost straight.* High altitude and latitude plants present numerous of these puzzling variations. The form with straight leaves seems common in the southern Appalachians. Peristomes of old deoperculate capsules sometimes fail to show the striations. Macoun's 36 has short capsules only slightly inclined and nearly symmetric but otherwise matches *D. scoparium.* There are many forms approaching subspecies *Bonjeani* and intermediate between the two, so that it is often a matter of opinion as to which species a given plant is to be referred.

21. DICRANUM BONJEANI DeNot. in Lisa, Elen. 29. 1837.

Dicranum palustre Bry. Eur. fasc. 37–40. *pl. 79.* 1847.
Dicranum diptoneuron C. Muell. Flora **70:** 221. 1887.
Dicranum leioneuron Kindb.; Macoun, Bull. Torr. Club **16:** 92. 1889.
Dicranum congestiforme C. M. & Kindb.; Macoun, Cat. Can. Pl. **6:** 29. 1892.
Dicranum plano-alare C. M. & Kindb.; Macoun, l. c. 31.
Dicranum undulifolium C. M. & Kindb.; Macoun, l. c. 32.
Dicranum subpalustre C. M. & Kindb.; Macoun, l. c. 33.
Dicranum Roellii Kindb.; Röll, Hedwigia **35:** 60. 1896.
Dicranum hyalinum Kindb. Röll. l. c. 61.
Dicranum perichaetiale Kindb.; Röll l. c. 61.
Dicranum alatum Card. & Thér. Bot. Gaz. **37:** *pl. 17.* 1904.

Subspecies of *D. scoparium,* from which it typically differs in the erect-spreading leaves, little changed when dry, sometimes undulate but rarely much curved, broadly acute to obtuse at the apex, margin and back of costa often little or not at all toothed; upper leaf cells usually more strongly pitted; capsule more frequently striate. Type locality, Italy.

ILLUSTRATIONS:—Bry. Eur. l. c.; Braithw. Brit. Moss Fl. **1:** *pl. 22B;* M. H. M. *f. 44; Pl. 46.*

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 66, (Ed. 2) 83; Aust. Musc. Appal. 92; Holz. Musc. Acro. Bor. Am. 354, 334, 133 as *D. scoparium orthophyllum,* a form with very serrate leaves toothed on back of costa, 262 as *D. Bergeri* f. *compacta* is much the same thing; in this the upper leaf cells are not at all those of *D. Bergeri.*

D. alatum (*D. Bonjeani* var. ALATUM Barnes, Bot. Centralb. **44:** 386. 1890), has the blunt leaves and short pitted upper leaf cells of *Bonjeani* with the secund leaves sharply serrate and toothed on the back of the costa as in *scoparium.* Holz. Musc. Acro. Bor. Am. 205 and 390. There are also similar forms with non-secund leaves as in Holzinger's 7 and 262. It is really a form intermediate between *scoparium* and *Bonjeani.* Holzinger's 206, *D. scoparium* f. *fragilis,* has the young upper leaves narrowly obtuse, entire and smooth on the back, but the older leaves are typical *Bonjeani.* Macoun's 49, from Victoria, Vancouver Island, his 27a, as *D. subscoparium,* from Laggan, Rocky Mts., Alberta, as well as plants collected by Cooper near the Stickine Glacier, have leaves of much the same sort as Holzingers' 206.

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* Var. *orthophyllum* Brid. = *D. subspadiceum* Kindb. Eur. and N. American Bryin. 199. 1897.

Doubtful and Excluded Species.

Dicranum Sendtneri Limpr. Laubm. **1**: 360. 1886. This is credited to Arctic N. America by Brotherus (Engler & Prantl, Laubm. (Ed. 2) **1**: 206). Of it the author says that it is one of the several forms intermediate between *D. fuscescens* and *D. elongatum*, yet nearer *D. fuscescens*, from which he has hesitated for a long time to separate it. To my mind there are too many species of arctic *Dicrana* recognized in this group. According to Limpricht's key it is distinguished from *D. elongatum* by the narrower costa, 1/7 the width of the leaf base, and the oblong upper cells, which last distinguishes it from *D. fuscescens*. Without seeing the type specimen it would be difficult to place this doubtful species.

The following are quoted from N. Am. Flora **15**[2]: 13.

Dicranum caespitans Schimp.; Besch. Mém. Soc. Sci. Nat. Cherbourg **16**: 164. 1872, is *Dicranella subinclinata*.

Dicranum Demetrii R. & C. Bot. Gaz. **22**: 48. 1896, is *Oncophorus Wahlenbergii*.

Dicranum Pittieri R. & C. Soc. Bot. Belg. **31**[1]: 146. 1893, is *Dicranodontium costaricense*.

Dicranum sublongisetum C. Muell. Bull. Herb. Boiss. **5**: 185. 1897, is *Dicranodontium longisetum*.

Dicranum subulifolium Kindb.; Macoun, Bull. Torr. Club. **17**: 87. 1890. This is a rather doubtful species. There are no specimens from the type locality, Cedar Hill, Vancouver Island, either in the collections at Ottawa or in the herbarium of the New York Botanical Garden, but under this name occur in the Macoun collections, no less than five species, as follows, *D. fragilifolium*, *D. groenlandicum*, *D. elongatum*, *D. Bergeri*, and *D. flagellare*.

11. DICRANODONTIUM Bry. Eur. fasc. 41. 1847.

Plants usually in compact tufts; stems slender, tomentose, sparingly branched; leaves setaceous from a lanceolate base, flexuose-spreading to more or less falcate-secund, often subtubulose above; costa broad, ⅓ of the leaf base or more, excurrent into a rough point, prominent on the back, in cross section near the leaf middle showing a median row of guide cells between two stereid bands and a row of somewhat larger cells on both faces, often radiculose on the lower dorsal face; alar cells enlarged and often inflated and colored; cells of basal lamina nearly quadrate to elongated, broader near the costa and narrower at the margin. Dioicous; seta nearly erect when dry, more or less curved when moist; capsule erect and symmetric, oblong to cylindric, without stomata; annulus lacking in our species; peristome teeth separate to below the capsule mouth, divided ¾ the way down or more, and mostly longitudinally striate below and papillose above; calyptra not fimbriate or ciliate at base. Type species, *D. denudatum*.

Differs from *Campylopus* in the entire calyptra and the structure of the costa, from *Dicranum* in the deeper division of the peristome teeth.

Key.

Leaves nearly smooth to serrulate ⅓–½ the way down ..... 1. *denudatum*.
Leaves sharply serrulate to the broad leaf base ..... 2. *asperulum*.

1. Dicranodontium denudatum (Brid.) E. G. Britton, N. Am. Flora **15**[2]: 151. 1913.

Dicranum denudatum Brid. Musc. Recent. Suppl. **1**: 184. 1806.
Didymodon longirostris Starke, in Web. & Mohr. Bot. Tasch. 155. 1807.
Dicranodontium longirostre Bry. Eur. l. c. *pl. 88*. 1847.
Dicranodontium virginicum E. G. Britton, in Millsp. Bull. W. Va. Expt. Sta. **2**: 488. 1892.
Dicranodontium Millspaughi E. G. Britton, l. c.

♀ plants in compact tufts, soft, silky and pale green; stems 4–8 cm. high; stem leaves 5–7 mm. long, the slender awn 4–5 times as long as the broader base, somewhat flexuose; margin subentire or finely toothed toward the apex; costa ⅓–½ the width of the leaf at base, bistratose at insertion, above this as described for the genus; alar cells thin-walled, hyaline or colored, somewhat inflated and reaching to the costa; lower lamina cells oblong to rectangular, near the costa 12–16 x 30–60 μ, somewhat pitted, narrower and thinner walled at the margin; inner perichaetial leaves the longest, convolute below. Seta about 1 cm. long, more or less curved; capsule oblong, smooth; peristome teeth cleft nearly or quite to their bases, or merely perforate below; operculum as long as the urn; spores 10–15 μ in diameter; mature autumn to winter, infrequently produced. Type locality, Thuringia, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 88;* Dixon, Handbk. Brit. Mosses (Ed. 3) *pl. 13C;* Braithw. Brit. Moss Fl. **1**: *pl. 17G; Pl. 43.*

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 71, (Ed. 2) 90; Holz. Musc. Acro. Bor. Am. 102.

On sandstone rocks and on peaty soil, usually in elevated regions in shaded places; New England to Alaska, south to Florida and Mexico.

2. DICRANODONTIUM ASPERULUM (Mitt.) Broth. Engler & Prantl (Ed. 1) Musci **1**: 336. 1901.

Dicranum asperulum Mitt. Jour. Linn. Soc. **3**: Suppl. 22. 1859.
Dicranodontium aristatum Schimp. Syn. 695. 1860.
Dicranum virginicum Aust. Bot. Gaz. **4**: 150. 1879.
Campylopus virginicus Lesq. & James, Man. 80. 1884.

Plants slender, dark- to light-green, tufted, lustrous, silky; stems ascending to erect, 3–10 cm. high; leaves erect-spreading to secund even when dry, straight to variously curved and flexuose, up to 6 mm. long, linear-lanceolate, from a broader base, *serrulate nearly to the base*, with a very rough awn; alar cells inflated and usually hyaline; costa ⅓ or more of the width of the leaf base, excurrent into a slender rough point; basal cells just above the alar, short-rectangular near the costa, about 15 μ wide, 1.5–3 : 1, narrower at the margin, much smaller higher up, often sublinear. Dioicous; male buds terminal, thick, borne on plants in separate tufts; seta 1.5–2 cm. long, sinuous and more or less arcuate when moist; capsule oblong, 1.5–2 mm. long; operculum rostrate, not quite the length of the urn; spores about 13 μ, mature in summer. Type locality, Sikkim. *Pl. 44.*

EXSICCATI:—R. & C. Musc. Am. Sept. 155.

On boulders and ledges in cool elevated regions; Pennsylvania and Virginia, south to Tennessee and Georgia; Williams reports from Alaska; also in Europe and Asia. Sporophyte rarely produced.

12. CAMPYLOPUS Brid. Musc. Recent. Suppl. **4**: 71. 1819.

Plants in more or less compact sods, varying in size, often robust, resembling *Dicranum* in appearance but with leaves more rigid, less flexuose; stems branching, sometimes with flagellate branches in leaf axils, or branches clustered at the summit, radiculose; leaves mostly straight and erect-spreading when moist, in some cases more or less secund, usually narrowly lanceolate from a broader ovate to oblong, or ovate-lanceolate base, usually trough-like or subtubulose just above the broader base and channelled above this, usually dentate above; costa percurrent to long-excurrent, in most species more or less ribbed or lamellose at back, very broad below and in a few species excurrent into a hyaline hair-point; alar enlarged cells extending to the costa, much or little differentiated from those next above, often reddish or brown; leaf cells at the margin of the upper base usually narrower and often hyaline; the cells of the very narrow upper lamina mainly short and rectangular to rhomboidal, linear in a few species. Dioicous; seta mostly strongly arcuate when moist, sinuous-erect when dry; capsule symmetric or somewhat curved, smooth or sulcate when dry and empty, sometimes rough at base; annulus well developed; peristome teeth like those of *Dicranella;* operculum beaked; calyptra cucullate and *fimbriate at base* in most cases. Type species *C. flexuosus.*

As the greater number of our species rarely or never fruit, their determination is a matter of considerable difficulty and has led to a considerable difference of opinion in several cases.

The costa of *C. Schimperi* in cross section consists of a ventral row of large thin-walled cells, below this two or three irregular rows of smaller cells with rather thicker walls, with none of the small thick-walled stereid cells. The costa of the other species is essentially on the plan described for *C. introflexus* but with much less prominent ribs, usually but one cell high.

KEY.

1. Costa without stereid bands; plants of high altitudes and latitudes	8.	*Schimperi.**
Costa with stereid bands; plants mainly of the southern U. S.		2.
2. Leaves with a hyaline hair-point on most or all of the older leaves		8.
Leaves without hyaline hair-points		3.
3. All or nearly all the cells of the broader leaf base more or less inflated and hyaline, alar cells not different	5.	*fragilis.*
Only the cells of the lower ½ or ⅓ of the leaf base enlarged or inflated		4.

* See p. 134.

4. Leaf cells of the upper lamina linear-flexuose, incrassate, with walls somewhat pitted ..... *1. angustiretis.*
   Leaf cells of upper lamina short-rectangular to oblong or rhomboidal ..... 5.
5. Leaves as a rule dentate at apex only ..... 6.
   Leaves toothed ⅓–½ the way down the slender awn ..... 7.
6. Inflated alar cells present in all fully developed leaves and separated from the small quadrate cells by a considerable number of elongated rectangular cells ..... *4. flexuosus.*
   Inflated alar cells not always present; small quadrate and shortly rectangular cells extending almost to these when present ..... *3. tallulensis.*
7. Enlarged cells extending about ⅓ the way up the broader leaf base, rather abruptly changing to small quadrate or short-rectangular cells ..... *3a.* var. *subleucogaster*
   Enlarged leaf cells extending up ½–⅔ the leaf base, rather gradually changing to the quadrate or rectangular to rhomboidal smaller cells ..... *2. gracilicaulis.*
8. Alar cells strongly differentiated, upper lamina cells narrowly oblong to linear. *7. atrovirens.*
   Alar cells scarcely differentiated, upper lamina cells short-oblong to obliquely rhomboidal ..... *6. introflexus.*

1. Campylopus angustiretis (Aust.) Lesq. & James, Manual 80. 1884.

Dicranum angustirete Aust. Bot. Gaz. **4**: 150. 1879.

Plants in rather loose tawny tufts; stems mostly simple, 1–3 cm. high, not radiculose except at and near base; leaves rather loosely imbricate when dry, straight and equally spreading, often somewhat clustered above, the upper longer, reaching 5 mm. or more in length, long-lanceolate, concave, channelled above; costa about ½–⅓ the width of the leaf base, in cross section like that of *C. gracilicaulis*, excurrent into a toothed awn; alar cells conspicuously and abruptly inflated, reddish in the older leaves; cells next above these near the costa short-rectangular, 15–20 μ wide; median cells of lamina linear-flexuose with somewhat porose incrassate walls, all the marginal cells above the auricles very narrowly long-linear. Type locality, Jacksonville, Florida. *Pl. 49.*

Exsiccati:—Holz. Musc. Acro. Bor. Am. 403, from "moist shaded sandy banks," Upsala, near Sanford, Florida (Rapp).

Distinguished from the common *C. gracilicaulis* by the narrower leaves less serrate above, more abruptly inflated and reddish colored alar cells and linear upper cells. Fruit unknown.

2. Campylopus gracilicaulis Mitt. Jour. Linn. Soc. **12**: 83. 1869.

Plants loosely gregarious or tufted; stems slender, up to 3 cm. high; lower stem leaves loosely appressed rather distant, the upper leaves and those of the very short subterminal branches forming a large compact terminal tuft, comal up to 6 mm. long, all narrowly lanceolate from a broader subclasping base, channelled above, serrulate about 1/3 the way down; costa shortly to longly excurrent, often extending into a long green strongly toothed arista, about 1/3 the width of the leaf at base, in the upper portion with low (1–2 cells) more or less toothed ribs, in cross section of a row of large clear ventral cells, below this a median row of slightly smaller chlorophyllose cells and at the back a layer of more or less interrupted stereid cells; alar cells more or less distinctly differentiated and inflated, above these a group of large short-rectangular cells extending up beside the costa and growing progressively narrower toward the margin, irregularly rectangular to rhomboidal or oblong, 1–2 : 1, smaller upwards; inner perichaetial leaves with a large ovate-oblong sheathing base in which the cells are larger and more lax than in the stem leaves, these large lax cells often nearly filling the entire base; costa ⅙–¼ the width of the base. "Capsule (immature) oval, unequal, rough at the base, hidden among the comal leaves on a reflexed seta about 9 mm. long; calyptra fimbriate at base." Type locality "Igarape da Cachoeira," Brazil (Spruce No. 60). *Pl. 49.*

Exsiccati:—Holz. Musc. Acro. Bor. Am. 355 (as *C. introflexus*), and 399.

Sandy fields and woods, Alabama, and common in southern Florida, where it has never been found in fruit, though archegonia are occasionally produced. Sometimes the plants have two stories, the upper apparently produced as an innovation from the lower comal tuft.

The type has been seen. The stem leaves are very strongly serrate above with the costa toothed on the back after the manner of *Dicranum scoparium*, and only shortly excurrent. The perichaetial leaves are

abruptly narrowed to a filiform rough awn with the costa long-excurrent. In most of the Florida plants that I have referred to this species the costa is less roughened and more longly excurrent. Some, however, match the Brazilian plant very closely in gametophyte characters. The alar cells in the type are only slightly or not at all differentiated. In the Florida plants they are much more differentiated. The calyptra is copiously fringed with long cilia; operculum about 0.7 mm. long. The leaf variation in the plants referred to this species is no greater than in our common *Dicranum scoparium.*

Plants in the U. S. National herbarium as *C. subleucogaster,* from Costa Rica, which I cannot differentiate from the common run of *C. gracilicaulis* from Florida, have perfect fruit matured in spring. When dry the seta is suberect and flexuose, but when moistened it becomes recurved bringing the capsule down to the leaves, it is 1 cm. or more in length. Capsule evenly striate when dry, symmetric, oblong, with a rough tapering neck; neck and urn 1.2–1.6 mm. long; operculum long-rostrate from a conic base, more than 1 mm. long; peristome teeth split nearly ½ the way down, reddish and longitudinally striate at base and on base of forks, which are spinose-papillose and hyaline above; calyptra ciliate at base; spores about 15 μ, finely papillose.

Gracilicaulis, Donnellii, fragilis, tallulensis, subleucogaster, and *flexuosus* all have a costa section similar to that of *introflexus* except that the ribs are mostly but one cell high.

2a. Var. DONNELLII (Aust.) **n. comb.**

Dicranum Donnellii Aust. Bot. Gaz. **4:** 150. 1879.
Campylopus Donnellii Lesq. & James, Man. 79. 1884.

Upper leaf cells longer and narrower, obliquely angled, 3–5 : 1.

EXSICCATI:—Aust. Musc. Appal. 470; Holz. Musc. Acro. Bor. Am. 402, 207.

Austin's original description cites his no. 470 and states that it occurred with *C. gracilicaulis.* A parallel column comparison of Williams' description of *gracilicaulis* and *Donnellii* shows little difference except the size and shape of the upper cells of the leaves. On sandy soil in Florida; frequent.

3. CAMPYLOPUS TALLULENSIS Sull. & Lesq. in Sull. Icones. Musc. 27. *pl. 17.* 1872.

Plants dark- to yellowish-green, brown and radiculose below; stems more or less branched, up to 4 cm. high; leaves erect-open when moist, loosely and evenly imbricated when dry or sometimes somewhat contorted, lanceolate from a broader base, up to 6 mm. long, subtubulose in the middle and channelled nearly or quite to the apex, finely toothed above; costa percurrent to shortly excurrent, ribbed and roughened to dentate on the back above (rarely to ⅓ the way down as in Holzinger's 481), ½–⅔ the width of the leaf at base, in cross section much like that of *gracilicaulis* or *fragilis;* alar cells usually inflated, hyaline or colored; just above these a few larger short-rectangular hyaline cells near the costa, becoming narrower towards the margin; *upper cells* of this broader basal portion of the leaf quadrate to short-rectangular, 7–10 x 7–14 μ, some occasionally broader than long, some rhomboidal, as are most of those in the narrow upper lamina. Type locality, Tallulah Falls, Georgia.

ILLUSTRATIONS:—Sull. Icones Musc. *pl. 17; Pl. 50.*

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 73b, (Ed. 2) 93; Small, Mosses southern U. S. 41; Holz. Musc. Acro. Bor. Am. 481 (not typical); Bartram, Mosses of Southern Arizona 103, as *C. subleucogaster.*

On soil and ledges that are moist during certain seasons; Tennessee, Georgia, Alabama, Arizona, Florida; not known in fruit.

The alar cells are often little inflated. Further the leaves on the same plant vary considerably in the areolation of the base. This does not include young leaves as the alar cells do not reach their full development until the leaves are fully mature. Dixon (Handb. Brit. Mosses 95) says that the inflated alar cells of *C. flexuosus* are "occasionally almost obsolete." Mexican and Central American plants have been referred to *C. flexuosus* by competent European authorities. To the author it seems that *flexuosus, talluensis* and *subleucogaster* belong to the same specific type. Certainly the differences are no greater than are found in plants generally referred to *Dicranum scoparium.* Macoun's Vancouver Island plant which Williams cites as *flexuosus* should be referred to *tallulensis* according to the leaf structure of the plants I have seen, if *tallulensis* is to stand. As a final decision, it is a synonym of *C. flexuosus.*

3a. Var. SUBLEUCOGASTER (C. Muell.) **n. comb.**

Dicranum subleucogaster C. Muell. in C. Mohr, Bull. Torr. Club. **5:** 49. 1879.
Dicranum zygodonticarpum C. Muell. Linnaea **42:** 471. 1878.
Campylocarpus subleucogaster Jaeger & Sauerb. Ber. St. Gall. Nat. Ges. **1877–78:** 381. 1879.

Leaf apex long and slender, strongly toothed, usually a greater area of large cells above the inflated alar cells. Type from Alabama, seen and studied. *Pl. 49.*

The above are the only material differences between the types of *Dicranum subleucogaster* and *Campylopus tallulensis* [Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 73b]. Besides the type collection it has been collected once or twice in Florida and reported from various other localities.

4. Campylopus flexuosus [L.] Brid. Musc. Recent. Suppl. **4**: 71. 1819.

Plants in compact sods, green above, brown and radiculose below; extremely variable in size and habit, 1–6 cm. high, often bearing flagellate clustered branches; leaves straight, small and rigid or long and flexuose when dry, sometimes secund above, lanceolate-subulate from an oblong base, tubular to channelled above, denticulate at the apex and occasionally farther down; costa, ½–⅓ the width of the base; costa and leaf cells much as in the last except that there are more elongated-rectangular cells between inflated alar cells and small quadrate cells. Seta 8–10 mm. long, curved; capsule about 2 mm. long, ovoid becoming oblong-cylindric when empty, furrowed, often somewhat unsymmetric; exothecial cells narrow, incrassate; annulus broad; peristome normal; operculum obliquely rostrate, ½–⅔ the length of the urn; calyptra fimbriate; spores finely papillose, 14–16 μ in diameter; mature late winter to spring. Type locality, European.

Illustrations:—Bry. Eur. *pl. 89;* Braithw. l. c. *pl. 18F;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 12B; Pl. 48.*

On moist shaded soil and rocks; Ohio, also in Mexico and Central America.

A careful comparison failed to show any important differences between this and *C. tallulensis* except that the short-rectangular and quadrate cells come closer to the inflated alar cells in *tallulensis* than in *flexuosus.* Small's Mosses of the Southern U. S. no. 41 seems to be *C. flexuosus.*

5. Campylopus fragilis [Dicks.] Bry. Eur. fasc. 41. *pl. 90.* 1847.

Bryum fragile Dicks. Pl. Crypt. Brit. **3**: 5. 1793.
Dicranum flexuosum var. *fragile* Turn. Musc. Hib. 74. 1804.
Dicranum densum Schleich. Exs. & Cat. 1807. (*C. densum* Bry. Eur. *pl. 93.*)
Campylopus pencillatus Brid. Musc. Recent. Suppl. **4**: 73. 1819.

Plants in compact tufts, up to 4 cm. high, usually shorter, more or less whitish below because of the pale bases of the leaves, which are up to 5 mm. long, densely imbricate, uniformly erect-spreading when moist, narrowly lanceolate from a broader concave base, serrulate in the upper ⅓, much like those of *C. introflexus* in costa and areolation, except as follows; nearly the whole broad basal portion of the lamina is made up of large, somewhat inflated cells, little different from the alar; the costa is shortly excurrent, with less prominent dorsal ribs and is bordered above by a very narrow band of short cells.

The capsule is bent down in the leaves by the curving of the 5–8 mm. seta; capsule pyriform-elliptic, symmetric, plicate when dry and empty; operculum rostrate, about ½ the length of the urn; annulus narrow; peristome normal; spores 14–16 μ. Type locality, Great Britain.

Illustrations:—Bry. Eur. l. c.; Braithw. Brit. Moss Fl. **1**: *pl. 18A;* Limpr. Laubm. **1**: 394. *f. 130;* Dixon, Handbk. Brit. Mosses (Ed. 3) *pl. 12B; Pl. 48.*

On soil in Florida, sterile only; rare.

6. Campylopus introflexus (Hedw.) Brid. Bryol. Univ. **1**: 472. 1826.*

Dicranum introflexum Hedw. Sp. Musc. 147. 1801.
Campylopus polytrichoides DeNot. Syll. Musc. 222. 1838.
Campylopus leucotrichus Sull. & Lesq., Sull. Icones. Musc. 28. *pl. 17.* 1864.
Campylopus longipilus Brid. Bryol. Univ. **1**: 477. 1826, in part.

Plants dark to golden green above, brown to blackish below, in rather close sods; stems 0.5–3 cm. or more high (reaching 7 cm. according to Limpricht), more or less branching, radiculose below; leaves loosely appressed-imbricate when dry, reaching 6 mm. in length, erect-open when moist, mostly lanceolate-subulate, straight, rigid, concave, channelled to subtubulose above, mostly ending in a rough hyaline awn of varying length, consisting of the excurrent costa, the upper tufted and longer, 2–5 mm. long; costa ⅔–¾ the width of the leaf base, with more or less serrulate ribs or lamellae 2–6 cells high on the back of the upper half, in cross section a little above the middle showing a ventral row of large clear, incrassate cells with

* For a full synonymy of this much named species see The N. Am. Flora **15**[2]: 144.

lumen about 7 μ, below these a row of similar chlorophyllose cells, and at the back stereid cells with interspersed large cells and then the large projecting cells of the ribs; alar cells little inflated, hyaline or colored, forming indistinct auricles; the cells next above these rectangular to sublinear, hyaline and running up the margin as in *Tortella*, rather abruptly passing into the small, very thick-walled cells of the middle lamina, which are quadrate or obliquely rhomboidal, obliquely arranged and much narrower at the margin, having a lumen 12–18 x 7–12 μ in some plants; "inner perichaetial leaves with a convolute blade extending nearly to the base of the hyaline rough point." Dioicous; seta 6–9 mm. long, rough near the capsule, flexuous; capsules often aggregated, short-oblong to ovoid, nearly symmetric, rugose at base and somewhat furrowed when dry and empty; operculum obliquely short-rostrate; perisome red-brown, the teeth split about ½ the way down; calyptra ciliate at base; spores rough, up to 13 μ. Type locality, New Zealand.

Illustrations:—Sull. l. c.; Hedw. l. c. *pl. 29, f. 1–7;* Braithw. Brit. Moss Fl. **1:** *pl. 19C;* Bry. Eur. *pl. 93;* Limpr. Laubm. **1:** 400. *f. 133;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 13a; Pl. 43.*

Exsiccati:—Bartram, Mosses Southern Arizona 54, 50 (a depauperate form without hyaline apex).

Tennessee, Georgia, Arizona, Mexico, W. Indies and southwards. Although apparently a moss of low latitudes, in N. America seems to be found on open cliffs and banks at a considerable altitude. Sharp's specimens from Tennessee have all the upper leaves with a long hyaline hair point, dorsal lamellae reaching 6 cells high and short oval or oblong cells. The description of the sporophyte is taken bodily from William's description in N. Am. Flora l. c. Small's Georgia Mosses 442 from the Canyon at Tallulah Falls, alt. 1400–1800 ft., April 1893, is undoubtedly *C. introflexus* although none of the leaves have hyaline points. His 139 from Little Stone Mt., April 1893 is the same thing with the lamellae a little higher and some of the leaves with short hyaline points. Also in Jackson Co., Ohio, a similar form was collected by A. J. Sharp.

Bartram's Mosses of S. Arizona no. 58, as *C. subleucogaster*, is also an epilose form of *C. introflexus*. These epilose forms may be distinguished from *C. tallulensis* by the less developed alar cells, wider costa and larger area of hyaline basal cells extending half way up the broad part of the leaf base. In *C. fragilis* this area of enlarged hyaline basal cells fills almost all the wider leaf base. Probably the epilose forms are merely juvenile or depauperate.

7. Campylopus atrovirens DeNot. Syll. Musc. 221. 1838. (Not of Bry. Eur. according to Limpricht, Laubm. **1:** 398, but cited as a synonym by Braithwaite, Brit. Moss Fl. **1:** 135.)

Campylopus longipilus Brid. Bryol. Univ. **1:** 477. 1826 (in part only).

Differs from *C. introflexus*, which it closely resembles, in the following characters:—the alar cells are strongly differentiated and inflated, the upper cells of the lamina narrowly oblong to linear and flexuose, often pitted; ribs on the costa mostly only one cell high. Bare cliffs, Chestnut Bald Mt., N. Carolina, alt. 5900 ft. Aug. 4. 1907 (Grout).

Identified and distributed as *C. introflexus* at the time, but careful comparison with European material makes it certain that it is this species.

Illustrations:—Bry. Eur. Suppl. fasc. 1–2, *pl. 3;* Braithw. Brit. Moss Fl. **1:** *pl. 19B;* Dixon, Handbk Brit. Mosses (Ed. 3) *pl. 12G; Pl. 48.*

13. BROTHERA C. Muell. Gen. Musc. 258. 1901.

A monotypic genus differing from *Campylopus* in having the cross section of costa showing a dorsal and a ventral layer of large cells and no stereid bands, alar cells not differentiated; seta erect but slightly sinuous, capsule erect.

Brothera Leana (Sull.) C. Muell. l. c. 259.

Leucophanes ? Leanum Sull. Musc. Allegh. 172. 1845.
Campylopus Leanus Sull. in A. Gray, Man. (Ed. 2) 619. 1856.
Leucobryum Leanum Kindb. Eur. & N. Am. Bryin. 176. 1897.
Brothera Ankerkronae C. Muell. Gen. Musc. 258. 1901.

Plants more or less densely cespitose, less than 1 cm. high, straw-color, darker below; stems radiculose throughout, branching by slender capitate fasciculate innovations, uniformly foliate; leaves crowded, erect-spreading, lanceolate-subulate, 2–3 mm. long (Williams says 3–3.5), channelled and entire above or with a few minute teeth at apex; costa broad and flat, filling most of the upper part of the leaf and ½ or more of the base, in cross section in the lower part of the leaf with a more or less disconnected row of somewhat smaller cells between the dorsal and ventral layers; cells of the lamina, pale, thin-walled, linear-oblong,

narrower at the margin, only a little larger at the base as a rule, occasionally some of the basal cells somewhat inflated; perichaetial leaves similar to the upper stem leaves; often in the axils of the upper leaves numerous narrow deciduous aborted or rudimentary leaflets, 0.5–1 mm. long. Dioicous, "seta up to 7 mm. long, smooth, erect, somewhat sinuous and twisted; capsule oblong to elliptic, 1–1.3 mm. long, without stomata, smooth above, slightly rugose at the base;" "annulus large, of two rows of cells; peristome teeth inserted below the mouth, divided to near the base into two subulate, indistinctly articulate, densely papillose forks; lid with a long erect beak; calyptra large, cucullate, ciliate at base; spores nearly smooth, 10–12 μ in diameter." (Description of fruit copied from N. Am. Flora **15**[2]: 134, which Williams drew mostly from a Japanese specimen, as N. Am. plants are sterile.) Type locality, Ohio.

ILLUSTRATIONS:—Sull. Icones Musc. *pl. 18; Pl. 50.*
EXSICCATI:—Sull. l. c., (Ed. 2) 94; Holz. Musc. Acro. Bor. Am. 9; Grout, Musci Perf. 272.
On bark of trees, rotten logs or humus in shaded localities; Pennsylvania, Ohio, Tennessee and Minnesota; also Siberia, the Himalaya region and Japan.

14. PARALEUCOBRYUM (Lindb.) Loeske, Hedwigia **47**: 171. 1908. Lindb. Musc. Scand. 23. 1879, as section of *Dicranum.*

Plants with a *Dicranum habit,* of medium size; costa very broad, not semiterete, filling all or nearly all the leaf above the middle, without guide cells, composed of 3–4 layers of cells of nearly uniform size and thickness of wall, the middle layer and often the lower layer also more or less chlorophyllose. Dioicous; capsules cylindric, erect and symmetric, or nearly so. Otherwise as in *Dicranum.* Type species *P. longifolium.*? Evidently this genus is a connecting link between *Dicranum* and *Leucobryum.*

KEY.

Costa 9/10 or more of the width of the leaf at base	*3. enerve.*
Costa often more than ½ the width of leaf base	*1. longifolium.*
Costa usually less than ⅓ the width of the leaf base	*2. Sauteri.*

1. PARALEUCOBRYUM LONGIFOLIUM (Hedw.) Loeske, l. c.

Dicranum longifolium Hedw. Stirp. Crypt. **3**: 24. *pl. 3.* 1791; Sp. Musc. 130. 1801.
Dicranum serratum Kindb. Eur. & N. Am. Bryin. 190. 1897.
Campylopus canadensis Kindb. Rev. Bryol. **32**: 35. 1905.
Dicranum albicans var. *denticulatum* Kindb.; Macoun, Cat. Can. Pl. **6**: 261. 1892.

Plants in rather dense silky tufts, light- to dark-green; stems slender, 3–4 cm. long, occasionally more; leaves little changed in drying, mostly falcate-secund, 4–7 mm. long, narrowly long-lanceolate, subulate-tubulose above and very rough; costa more than ½ the width of the leaf base, occupying all the upper part of the leaf, in cross section as described for the genus, ribbed on the back; inflated alar cells reaching the costa; cells of the narrow lamina hexagono-rectangular, 4–6 : 1, with the walls somewhat pitted, smaller upwards; perichaetial leaves abruptly subulate from a broad clasping base having a much broader lamina. Seta 1–2 cm. long; capsule nearly erect and symmetric, oblong-cylindric, somewhat wrinkled when dry and empty, 2–2.5 mm. long; operculum long-rostrate, scarcely as long; annulus lacking; peristome teeth split more than ½ down, obliquely striate below; spores 18–24 μ, maturing in summer. Type locality, European.

ILLUSTRATIONS:—Hedw. l. c.; Bry. Eur. *pl. 72;* M. H. M. *pl. 17;* Braithw. Brit. Moss Fl. **1**: *pl. 24B;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 15H; Pl. 44.*
EXSICCATI:—Drumm. Musc. Am. 94; Sull. Musc. Allegh. 161; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 58, (Ed. 2) 74; Aust. Musc. Appal. 84; R. & C. Musc. Am. Sept. 294; Holz. Musc. Acro. Bor. Am. 132; Grout, Musci Perf. 158, 181.
On rocks, more rarely on bases of trees in alpine or subarctic regions; Newfoundland to Alaska; south to North Carolina and Colorado.

1a. Var. SUBALPINUM Milde, Bryol. Siles. 68. 1869.

A reduced alpine form with leaves blackish, nearly straight and equally spreading, shorter and less roughened above. Probably in suitable habitats throughout the northern range of the species. Holz. Musc. Acro. Bor. Am. 294.

2. PARALEUCOBRYUM SAUTERI (Schimp.) Loeske, l. c.

Dicranum Sauteri Bry. Eur. fasc. 37–40. *pl. 71.* 1847.
Campylopus frigidus Lesq.; Porter & Coult. Syn. Fl. Colo. 155. 1874, in part.

Subspecies of *P. longifolium;* distinguished by the shorter leaves, smoother above, much broader leaf lamina and costa usually less than ⅓ the width of the leaf base; peristome teeth smoother, little or not at all striate. Type locality, Austria.

ILLUSTRATIONS:—Bry. Eur. l. c; *Pl. 51.*
Mountains of British Columbia, Colorado and Arizona.

3. PARALEUCOBRYUM ENERVE (Thed.) Loeske, l. c.

Dicranum enerve Thed.; Hartm. Skand. Fl. (Ed. 5) 393. 1849.
Dicranum albicans Bry. Eur. fasc. 43. Dicranum Suppl. *pl. 73.* 1850.
Campylopus Hallii Lesq.; Porter & Coult. l. c. 155.

Plants in compact tufts, light-green; stem leaves in robust European plants sometimes falcate secund; American plants are mostly slender and differ from *P. longifolium* in having leaves erect-spreading, nearly straight, with only a thin line of lamina above the alar cells; usually entire and smooth above, sometimes with a few teeth at apex; operculum as long as urn. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. l. c.; *Pl. 51.*
EXSICCATI:—Macoun, Can. Musci 56, 404.
On rocks; arctic-alpine; Alaska, British Columbia, Colorado and New Mexico; rare in N. America.

KEY TO GENERA.

1.	Alar cells not conspicuously enlarged or inflated	2.
	Alar cells conspicuously enlarged or inflated or both (*Blindia* may be sought here)	13.
2.	Leaf cells smooth or nearly so	3.
	Leaf cells strongly papillose or mamillose	10.
3.	Leaves not crisped when dry	4.
	Leaves crisped when dry (except forms of *6*)	6.
4.	Stems julaceous; stem leaves erect-appressed, ovate to ovate-lanceolate, obtuse	*2. Angstroemia.*
	Stems not julaceous; leaves not appressed, narrowly lanceolate from a broader base	5.
5.	Costa at least ¾ the width of the leaf base	*13. Brothera.*
	Costa less than ⅓ the width of the leaf base	*1. Dicranella.*
6.	Capsule deeply ribbed when dry	7.
	Capsule smooth or slightly striate when dry	9.
7.	Peristome teeth divided at least ½ the way down (nos. 1, 2, 3)	*6. Oncophorus.*
	Peristome teeth not divided (except occasionally at extreme apex)	8.
8.	Leaf margins serrulate (in our species); peristome teeth linear-lanceolate	*3. Rhabdoweisia.*
	Leaf margins entire except at extreme apex; peristome teeth lanceolate	*8. Dicranoweisia.*
9.	Capsules strumose (Nos. 8. 9. 10)	*6. Oncophorus.*
	Capsules not strumose	*7. Symblepharis.*
10.	Leaf margins bistratose (Nos. 1, 3, 7)	*6. Oncophorus.*
	Leaf margins unistratose	11.
11.	Larger radicles often papillose; peristome teeth undivided	*4. Oreoweisia.*
	Radicles smooth; peristome teeth divided at least ½ the way down	12.
12.	Capsules ribbed when dry (Nos. 4, 5, 6)	*6. Oncophorus.*
	Capsules not ribbed when dry	*5. Dichodontium.*
13.	Costa semiterete, less than ⅓ the width of the leaf base	14.
	Costa flattened, at least ⅓ the width of the leaf base	16.
14.	Peristome teeth undivided, with vertical striae few or lacking	*8. Dicranoweisia.*

Peristome teeth divided about ½ the way down, vertically striate on the outer face in most species ..... 15.
15. Costa of homogeneous cells ..... *9. Arctoa.*
Costa of heterogeneous cells ..... *11. Dicranum* and *6. Oncophorus.* sp.
16. Costa without stereid bands ..... 17.
Costa with well defined stereid bands above and below the guide cells... 19.
17. Large empty cells on both surfaces of the costa ..... *13. Brothera & Paraleucobryum.*
Large empty cells on the upper surface only of the costa ..... 18.
18. Guide cells present; calyptra fimbriate; capsule without stomata ..... *12. Campylopus Schimperi.*
Guide cells lacking; calyptra not fimbriate; capsules with stomata ..... *14. Paraleucobryum.*
19. Upper surface cells of the costa larger than the guide cells; calyptra fimbriate ..... *12. Campylopus.*
Median guide cells the largest cells in cross section of costa; calyptra not fimbriate ..... *11. Dicranodontium.*

LEUCOBRYACEAE.

Plants with sporophyte structure much like that of the *Dicranaceae.* The whitish gametophyte differs in that the stem has no central strand and that the leaves consist mostly of a costa of three or more layers of two kinds of cells, the outer large, hyaline and porose on the inner walls, without chlorophyll (leucocysts). These inclose a row, rarely more, of small chlorophyll bearing cells (chlorocysts), which are angled and 3–4-sided.

Key.

Leaves plane above, widely spreading to recurved when dry; chlorocysts triangular in cross section; capsules erect and symmetric; peristome teeth 8 ..... *1. Octoblepharum.*
Leaves subtubulose above, less widely spreading when dry; chlorocysts 4-sided in cross section; capsules unsymmetric, inclined, often strumose; peristome teeth 16, forked as in *Dicranum* ..... *2. Leucobryum.*

OCTOBLEPHARUM Hedw. Stirp. Crypt. **3**: 15. *pl. 6A.* 1791; Sp. Musc. 50. 1801.

We have only the type species.

Octoblepharum albidum (L.) Hedw. l. c.

Plants usually in small tufts, rather compact, whitish, rarely tinged with reddish; stems branching, 0.5–3 cm. long, branching; leaves scarcely changed in drying, widely spreading to recurved, up to 6 mm. or more in length, oblong-lingulate from a broader more hyaline and more erect base, narrowed to the insertion, rounded-apiculate and serrulate at apex, in median cross-section showing mostly 4 layers of cells above and 3 below the triangular chlorocysts; lamina at base, small and narrow; perichaetial leaves little differentiated. Autoicous, male flowers scattered along the stem; setae mostly solitary, erect and straight, 4–7 mm. long; capsule ovoid to short-oblong; erect and symmetric; operculum obliquely short-rostrate; annulus lacking; peristome teeth 8, triangular, smooth, lightly striate longitudinally, sometimes perforate along the median line; spores rough, up to 22 μ, mature in winter. Type locality, Bahamas.

Illustrations:—Hedw. l. c.; *Pl. 52.*
Exsiccati:—Aust. Musc. Appal. 478; R. & C. Musc. Am. Sept. 213; Small, Mosses southern U. S. 52; Grout, Musci Perf. 46; Holz. Musc. Acro. Bor. Am. 57.
Principally on the bases of trees and trunks of palms; common in southern Florida. Also reported from Texas by Austin.

2. LEUCOBRYUM Hampe, Flora **20**: 282. 1837.

Plants in dense whitish cushions, round and wide spreading in maximum development, brittle when dry; stems branching, up to 20 cm. long; leaves oblong-lanceolate, rather crowded, with an appressed-imbricate base and a more or less spreading subtubulose upper portion, which is sometimes secund (rarely so in our species) mostly denticulate at apex, all parts composed mostly of the highly developed costa with a very narrow lamina in the basal portion; costa in cross section consisting of a single row of small quadrate

sharply angled chlorocysts with from one to 4 rows of leucocysts on each side; lamina a hyaline border in the lower part of the leaf composed of 5–10 rows of narrow hyaline cells; radicles often appear at the apex of the leaves. Sporophyte dicranoid; capsule on a long-exserted seta, more or less inclined and unsymmetric, more or less striate when dry and empty; operculum long-rostrate; annulus and stomata mostly lacking; peristome teeth forked, more or less striate longitudinally and papillose on the prongs. Type species *L. glaucum.*

KEY.

1. Leaves up to 4.5 mm. long, upper tubulose portion not longer than the broad appressed portion, usually shorter ..... *2. albidum.*
   Leaves up to 10 mm. long, upper tubulose portion longer than the basal portion, up to 3 times as long ..... 2.
2. Leaves erect-spreading at a small angle when dry, in cross section near the base showing in part 3–4 rows of leucocysts ..... *1. glaucum.*
   Leaves spreading-flexuose at a much wider angle, in cross section near the base showing only a single row of leucocysts on each side of the chlorocysts ..... *3. antillarum.*

1. LEUCOBRYUM GLAUCUM (Hedw.) Schimp. Coroll. Bry. Eur. 19. 1855.

Dicranum glaucum Hedw. Stirp. Crypt. (Fundamant?) **2**: 92. 1782 and Sp. Musc. 136. 1801.
Leucobryum vulgare Hampe, l. c.

Mature plants in deep rounded cushions up to 10 cm. or more high, peaty below; leaves crowded, 3–10 mm. long, from an oblong or ovate base gradually narrowed to a subtubular narrower upper portion, minutely denticulate at the abruptly acute apex; costa in cross section near the base showing a single or usually a partially double row of leucocysts on the upper and lower side of the chlorocysts and in the thickest part of the leaf with 2–3 layers of leucocysts above and below the single chlorocyst layer; hyaline lamina on each side of the base about 5 cells wide. Psudautoicous; male plants 2–6 mm. high, growing on tufts of tomentum within the lower perichaetial leaves; capsule usually distinctly strumose, strongly curved and furrowed when dry, 1.5–2 mm. long, on a seta 1.5–2 cm. long; operculum about the length of the urn; spores 15–20 μ; mature in autumn and persisting through the winter. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 97, 98;* Braithw. Brit. Moss Fl. **1**: *pl. 13;* Dixon, Handbk. Brit. Mosses (Ed. 3) *pl. 16B;* Limpr. Laubm. **1**: 420. *f. 141;* M. H. M. *f. 49;* Mosses w. Hand-lens *pl. 24; Pl. 52.*
EXSICCATI:—Drumm. Musc. Am. 89; Sull. Musc. Allegh. 168; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 76, (Ed. 2) 97, 98 in part; Aust. Musc. Appal. 99; Macoun, Can. Musci 55; Holz. Musc. Acro. Bor. Am. 82, 618; Grout, Musci Perf. 44; R. & C. Musc. Am. Sept. 277, as *L. albidum.*
On soil and rocks in shaded places, very common but fruiting infrequently; Newfoundland to Minnesota; south to Florida and Louisiana. Although the species thrives in places that are rather dry most of the time, it seems to fruit more freely when more abundant moisture is present.

2. LEUCOBRYUM ALBIDUM (Brid.) Lindb. Oefv. Sv. Vet.-Akad. Förh. **20**: 403. 1863.

Dicranum albidum Brid. Musc. Recent. **2**[1]: 167. 1798 and Sp. Musc. 205. 1806.
Dicranum glaucum pumilum Mx. Fl. Bor. Am. **2**: 297. 1803.
Leucobryum vulgare minus Hampe, Linnaea **13**: 42. 1839.
Leucobryum sediforme C. Muell. Syn. **1**: 75. 1848.
Leucobryum minus Hampe; Sull. in A. Gray, Man. (Ed. 2) 624. 1856.
Leucobryum pumilum E. G. Britton, Bull. Torr. Club. **19**: 190. 1892.
Leucobryum incurvifolium C. Muell. Bull. Herb. Boiss. **5**: 174. 1897.

Smaller than the last, up to about 3 cm. high, with the leafy stems much more slender; leaves smaller, 2–4.5 mm. long, with the narrowed subtubulose point rarely as long as the broad base and often much shorter; capsules more frequently not strumose, averaging smaller. Type locality, Virginia. *Pl. 52.*

EXSICCATI:—Drumm. Musc. Am. 40, 45; Sull. Musc. Allegh. 169; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 77, (Ed. 2) 98 in part; Aust. Musc. Appal. Suppl. 477; Small, Mosses southern U. S. 17; R. & C. Musc. Am. 18; Holz. Musc. Acro. Bor. Am. 56; Grout, Musci Perf. 45.
On soil, fallen logs and bases of trees; Connecticut (Det. Williams) to New Jersey and Ohio; south to Florida and Texas. Common in Florida.
The southern plants are very distinct but become less so towards their northern limit. Immature or depauperate specimens are hard to place.

3. LEUCOBRYUM ANTILLARUM Schimp.; Besch. Ann. Sci. Nat. VI. **3**: 190. 1876.

Leucobryum costaricense Besc. Journ. de Bot. **11**: 153. 1897.
Leucobryum Jamaicense C. Muell. Bull. Herb. Boiss. **5**: 547. 1897.
Leucobryum subglaucum C. Muell. l. c. 548.
Leucobryum sciuroides C. Muell. Hedwigia **37**: 221. 1898.
Leucobryum Eggersianum C. Muell. Hedwigia l. c.
Leucobryum glaucovirens Card. Rev. Bryol. **36**: 69. 1900.
Leucobryum flaccidulum Card. Rev. Bryol. **37**: 119. 1910.

(This synonymy is after Williams, N. Am. Flora 15^2: 165.)

Plants in rather loose tufts, differing from *L. glaucum* in the more widely spreading and flexuous leaves, showing in cross section near the base but a single layer of leucocysts each side of the row of chlorocysts, marginal lamina up to 8 cells wide. Capsules smaller and less curved. Type locality, Guadeloupe. *Pl. 52.*

Throughout the West Indies and from Mexico to northern S. America. Collected near Sebring, Florida, by J. B. McFarlin. Plants occur that can be told from *D. glaucum* by careful dissection only.

Family POLYTRICHACEAE*

Plants largely stiff and coarse, most species becoming reddish or brownish at least with age, mostly forming loose to dense sods; stems erect, at least usually from a creeping branched rhizome, commonly with the basal portion bearing reduced and usually very small bracts, with central strand of two kinds of cells; *leaves* mostly with sheath, in nearly all *with* longitudinal *lamellae on the upper side*, often crispate when dry; costa one, narrow, or indefinitely wide; cells of the upper half of the limb isodiametric to somewhat wider than long or somewhat longer than wide. Calyptra often quite hairy; seta long; capsule well exserted; *teeth* 0, 32 or approaching 64 through doubling, *in 1 row*, composed *of whole thickened cells, unbarred.*

KEY

A. Leaf limb between the lamellae and the margin 1 cell thick except the elongate border cells when present; capsule with peristome.
  B. Lamellae on upper side of leaf 1–15, sometimes none on most of the leaves of *Atrichum crispum;* about the middle of the limb the unistratose region more than 8 cells wide; capsule not longitudinally ridged, without hypophysis; calyptra smooth or nearly so; marginal cells of the lamellae like the others, not thicker walled.
    C. Leaves bordered with long narrow cells; capsules without stomata..... *1. Atrichum.*
    CC. Leaves not bordered with long narrow cells; capsules with stomata..... *2. Oligotrichum.*
  BB. Lamellae 25–70 (except in *Pogonatum pensilvanicum* only 10–15); about the middle of the limb the unistratose portion 1–8 cells wide; capsule longitudinally ridged in most species, with distinct hypophysis in most species; calyptra long-hairy, densely so except in *Polytrichadelphus Lyallii.*
    D. Capsule terete; calpytra densely long-hairy; capsule with or without stomata; teeth of peristome 32 or these more or less completely doubled.... *5. Pogonatum.*
    DD. Capsule 4–6-angled; capsule with stomata; teeth of persitome 64.
      E. Capsule longitudinally 4-ridged, the two upper ridges closer together; calyptra sparingly hairy and thus its body quite easily seen..... *4. Polytrichadelphus.*
      EE. Capsule longitudinally 4–6-ridged, the ridges equally spaced; calyptra densely long-hairy and thus its body hidden..... *6. Polytrichum.*
AA. Leaf limb between lamellae and margin 2 cells thick throughout most of its area; capsule without peristome; calyptra smooth; marginal cells of the lamellae like the others at least in thickening; plants known only from Greenland, Alaska and British Columbia..... *3. Lyellia.*

* By Dr. Theodore C. Frye of the University of Washington. Dr. Frye's citations are often a little different in form from those used in other parts of the book, but they are usually a little more complete and will be easily correlated.

The following have materially assisted in the preparation of this work: Mrs. Elizabeth Young in arrangement, reading of typed matter and making of drawings; in the making of drawings Elizabeth Curtis, Sylvia Edmonds and Harriet Rudolf. Drawings made by the above are initialed.

Synopsis of the Genera

Hairs of the calyptra wanting or too few to hide its body.
- Peristome with teeth; lamina 1 cell thick except sometimes the border.
  - Capsule without longitudinal ridges; lamellae few, rarely none.
    - Leaves bordered with long narrow cells; capsules without stomata . . . *Atrichum.*
    - Leaves not bordered with long narrow cells; capsules with stomata . . . *Oligotrichum.*
  - Capsule with 4 (or 2) longitudinal ridges; lamellae numerous. . . . . *Polytrichadelphus.*
- Peristome wanting; lamina 2 cells thick in most of its area . . . . . *Lyellia.*

Hairs of the calyptra completely hiding its body.
- Capsule terete . . . . . *Pogonatum.*
- Capsule longitudinally ridged . . . . . *Polytrichum.*

1. ATRICHUM Beauv. Prodr. 42. 1805.

Catharinea Ehrh., Han. Mag. **1780**: 933. 1780; also Beitr. **1**: 178. 1787.

Plants rather vigorous, green or later brownish or reddish, forming thin sods or patches; erect stems from subterranean twisted and much branched rhizomes, simple, with central strand, densely rhizoidous at base; *leaves* flat to involute-tubular, *without sheath*, often transversely undulate, ligulate to linear-lanceolate, *bordered* with elongate cells, mostly crispate when dry; margin singly or doubly serrate; lamina often with teeth on the back; costa vanishing or percurrent, toothed on the back above, *with a few lamellae* on the upper side; even the *marginal cells of the lamellae smooth;* leaf cells quite green, smooth (except 4 & 5), the upper roundish-hexagonal, the lower mostly rectangular. Dioicous or monoicous; *calpytra narrow*, cucullate, *smooth or* with the tip from *slightly papillose to slightly hairy;* setae 1–6 from a stem tip; capsule somewhat inclined, smooth, commonly longly cylindrical, often slightly curved, terete, without hypophysis constricted from the urn; *stomata none;* teeth 32; lid convex, beaked.

Atrichum is a *nomen conservandum.* Ehrhart's spelling of *Catharinea* was corrected by O. Sendtner in Habilitationsschrift 14, 1848, to *Catharinaea*, the feminine form. Since that time some authors have followed one spelling and some the other. Type species, A. undulatum (Hedw.) P. B.

Key

A. Leaf cells smooth.
- B. Leaves ovate to elliptical or obovate.
  - C. Teeth abortive or wanting on back of costa near tip; lamellae 0–3 cells high; cells of leaf at 3/4 up markedly smaller toward margin . . . . . 1. *crispum.*
  - CC. Teeth present on back of costa near tip; lamellae 4–8 cells high; cells of leaf at 3/4 up slightly smaller toward margin . . . . . 1a. *Var. molle.*
- BB. Leaves lingulate to somewhat lanceolate.
  - D. Leaves wide, 1/5 or less of the width at half way up obscured by costa and lamellae; lamellae 2–6 cells high, or up to 13 in *A. undulatum* var. *Selwyni.*
    - E. Costa and its lamellae at half way up obscuring 1/11–1/7 of the leaf width.
      - F. Lamellae low, 2–6 cells high.
        - G. Setae 1 from a tip or rarely a tip with 2, terminal; antheridia and archegonia at least usually on separate tips. . . . . 2. *undulatum.*
        - GG. Setae 2–6 from a tip or rarely a tip with only 1, apparently lateral through their persistence and the renewed growth of the stem tip; usually the antheridia central with archegonia in a circle around them. . . . . 2a. Var. *Haussknechtii.*
      - FF. Lamellae at their highest part reaching 6–13 cells. . . . . 2b. Var. *Selwyni.*
    - EE. Costa and its lamellae at half way up obscuring 1/7–1/5 the leaf width; leaves short . . . . . 2c. Var. *minor.*

DD. Leaves narrow, 1/4–2/3 of the width at half way up obscured by costa and lamellae; lamellae 7–14 cells high at highest point.
H. Lamellae 4–8, 7–9 cells high at highest point; costa and lamellae obscuring 1/4–1/3 of the leaf width at half way up; capsule curved . . . 3. *angustatum.*
HH. Lamellae 7–12, 8–14 cells high at highest point; costa and its lamellae obscuring 1/2–2/3 of the leaf width at half way up; capsule nearly straight . . . 3a. Var. *plurilamellatum.*
AA. Leaf cells finely papillose.
I. Capsule long, 3.5–6 mm.; teeth of the peristome about 200 μ long, from a basal membrane about 100 μ high; median cells of the leaf base 45–50 x 100–150 μ . . . 4. *papillosum.*
II. Capsule short, 1.5–2.5 mm.; teeth of the peristome about 100 μ long, from a basal membrane about 50 μ high; median cells of the leaf base 12–17 x 19–43 μ . . . 5. *Macmillani.*

1. ATRICHUM CRISPUM (James) Sull., in A. Gray, Man. (Ed. 2) 641. 1856.

Catharinea crispa James, Proc. Acad. Nat. Sci. Philadelphia **7**: 445. 1855.
Catharinaea crispa var. *densifolia* Lindb., Not. Saellsk. Fauna Fl. Fenn. **9**: 149. 1867.
Atrichum crispum var. *densifolium* Paris, Index Bryol. (Ed. 1) 52. 1894.

Plants gregarious, small or mediumly robust, dull or yellowish-green, brownish when old; stems simple, from a branched rhizomatous base, 1–3–5 cm. long, distantly leafy, bracteate below, with rhizoids at base; *leaves* crispate when dry, spreading when moist, without sheath, *oval-oblong or lanceolate-oblong;* larger leaves 4–5 mm. long, 0.9–1.1 mm. wide, 4–5 times as long as wide, *not or hardly undulate; lamina not toothed on back,* 1 cell thick; apex obtusely acuminate, often ending in a tooth like the marginal ones; margin serrate in the upper 1/2–2/3, its teeth largely single but some double on each side; leaf border of long narrow cells from very near base to tip, 1–3 cells wide, 1–2 cells thick, its cells with thick walls; costa percurrent or excurrent, at the leaf middle 90–105 μ wide and constituting 1/11–1/10 of the leaf width, occasionally with a tooth on the back near the apex, *with lamellae* on upper side from the apex to below middle, *or some leaves without them; lamellae 0–4,* frequently interrupted, *1–3 cells high,* entire, smooth, not undulate, the marginal cells like the others and not incrassate; leaf cells at 3/4 up 20–45 μ in longest diameter, quadrate-hexagonal to roundish, smaller toward the margin, inclined to be longer transversely; those of the median base rectangular, 1–3 times as long as wide; those of the marginal base narrower. Leafy stems dioicous; male plants taller, in separate clusters; calyptra 3.5–4 mm. long, cleft to about the middle, quite hispid at tip; setae 14–21 mm. long, smooth, usually 1 but occasionally 2–3 from the same tip; capsule terete, erect or nearly so, slightly curved, gradually narrowed at base; urn 2–3.5 mm. long, 600–700 μ wide at the mouth, 3–4.5 times as long as wide, longitudinal walls of the epidermis incrassate; stomata wanting; lid conic, beaked, the beak about half as long as the urn; teeth of the peristome 32, simple, unequal, 160–200 μ long, 31–34 μ wide, 5–6 times as long as wide; basal membrane projecting only about 0.1 the length of the teeth; spores 16–22 μ, smooth. Type locality, Camden, New Jersey (James).

ILLUSTRATIONS:—Sull. Icones Musc. *pl. 46;* Braithw. Brit. Moss Fl. **1**: *pl. 5C;* Dixon & Jam. Stud. Handb. Brit. Mosses (Ed. 3) *pl. 5B;* Proc. Wash. Acad. Sci. **12**: 277. *f. 1;* M. H. M. *pl. 7; Pl. 53A.*

EXSICCATI:—Aust. Musci Appal. 231; Grout, N. Am. Musci Perf. 162, 316, Hand-lens Mosses 8, Bryol. Distrib. Mosses 30; Holz. Musci Acro. Bor. Am. 99; Macoun, Can. Musci 464 (as *Catharinea xanthopelma*), 567; Sharp, Fl. Tennessee Bryo. 35331; Sull. & Lesq. Musci Bor. Am. 209b.

On banks of streams and on moist soil. Vermont, New York, Ontario and southward to Tennessee; British Columbia; Oregon. Iowa (Conard)

The various collections differ considerably in the maximum and minimum dimensions of the leaf cells. The variety *densifolia* is believed to be a form growing under difficulties. The leaves of all species of *Atrichum* grade into bracts downward on the stem. The bracts have less development of lamellae, and are wider in proportion to their length than the larger leaves. The largest leaves on the variety compare very well with the smaller leaves of *A. crispum* which are on the region of the stem where gradation into bracts is evident. If a plant of *A. crispum* grew under difficulties so its stem ceased to grow before forming its largest leaves, it would be the variety.

Of this variety the material examined was collected by A. Richards at Oakmere, Cheshire, England, in 1910; and by A. J. Sharp on Mt. LeConte, Tennessee, October 2, 1932. Braithwaite, in British Moss Flora 1: 42, 1887, says the fertile plant has been found only in North America. We have seen no capsules. However, the variety was erected on the leafy plant and not on the capsule.

1a. Var. MOLLE (Holz.) **n. comb.**

Catharinaea mollis Holz. Musci Acro. Bor. Am., No. 48. 1904.

Stems 1–2 cm. long, proliferous through the antheridial disk; leaves lingulate-lanceolate, not undulate, up to 2–3.5 mm. long, 750–850 μ wide, 2–4 times as long as wide; apex acute; margin commonly serrate in the upper 1/4–1/2; the teeth short, or on some leaves wanting or few; *cells* at 3/4 up *17–24* μ in longest diameter, almost isodiametric but rather longer transversely; *lamellae 2–5, 4–8 cells high,* entire or slightly crenulate. Type locality, Marshland, Wisconsin (J. M. Holzinger) June, 1903. *Pl. 53, figs. 11–13.*

EXSICCATI:—Holz. *l. c.*
Examined:—Manatee, Florida (*Grout & MacFarlin 435*) 1931.
On moist soil. Wisconsin; Florida.
The smooth leaves, wider above the base, and with weak marginal teeth place it with *A. crispum* rather than with *A. undulatum.* It differs from *A. crispum* however in the smaller cells, the higher lamellae, and the weaker development of marginal teeth. The description of the plant is printed on the label in Holzinger's exsiccati.

2. ATRICHUM UNDULATUM (Hedw.) Beauv. Prodr. 42. 1805.

Polytrichum undulatum Hedw. Sp. Musc. Frond. 98. 1801.
Catharinea undulata Web. & Mohr, Ind. Mus. Pl. Crypt. 1803.
Oligotrichum undulatum Lam. & De Cand. Fl. France (Ed. 3) **2:** 492. 1805.
Catharinea Ehrharti Voit. Musc. Frond. & Herbipolitano 17. 1812.
Callibryum undulatum Zenk. & Dietr. Musc. Thuringici, No. 41. 1822.
Catharinea callibryon C. Muell. Syn. Musc. Frond. **1:** 192. 1849.

Plants dark-green, quite vigorous for the genus; stems up to 8 cm. long, simple or rarely branched, with a polytrichoid central strand, leafy above, bracteate below; leaves crispate, widely spreading when moist, unsheathed, rather distant; largest leaves 5–9 mm. long, 1–1.3 mm. wide, ligulate, bordered, serrate; *lamina undualte, with teeth on back* on the undulations, 1 cell thick but 2 at the insertion; apex acute, often ending in a tooth like the marginal ones; margin serrate from the base or nearly there to the tip; teeth largely double, coarse, incrassate; border along the upper 4/5–9/10 or disappearing between the teeth near the tip, 1–3 cells wide, mostly 2 cells thick, of long narrow cells with thick walls; costa percurrent or barely vanishing, 70–110 μ wide near middle and constituting 1/9–1/10 the median leaf width, or *with its lamellae obscuring 1/7–1/11 the median leaf width,* with a few teeth on back near tip, lamellose on upper side; lamellae 2–6, on the upper 1/2–3/4 of the leaf, *2–6 cells high,* entire, not undulate, grading into costa below, composed of broken longitudinal rows of cells, the marginal smooth like others; leaf cells at 3/4 up in somewhat broken longitudinal rows, mostly 4–6-sided, often the transverse diameter the longer, smooth, 18–40 μ in longest diameter; those of the base midway between the costa and margin 2–3 times as long as wide; those of the marginal base 6–10 times as long as wide; bracts of the lower stem shorter than the leaves, wider for their length. Leafy plants polyoicous, at least some stems bearing only antheridia the first year and only archegonia in succeeding years; calyptra rough at tip but not hairy, covering about 1/3 the capsule; setae 1 or rarely 2–3 from the same tip, 2–4 cm. long, straight, reddish, smooth, hollow; capsule terete, inclined, cylindric, gradually narrowed at base, without stomata; urn 4–5 mm. long, 700–800 μ thick, slightly curved, sometimes shorter and almost regular, its epidermis with strongly incrassate longitudinal walls; lid almost as long as the body of the capsule, rostrate from a hemispheric base; teeth 32, single, 220–320 μ long, 50–80 μ wide, 4–5 times as long as wide, from a basal membrane 80–100 μ wide; spores 9–23 μ, almost smooth. Type locality, European.

ILLUSTRATIONS:—B. S. G. Bryol. Eur. *pl. 410;* Braithw. Brit. Moss Fl. **1:** *pl. 5B;* Proc. Wash. Acad. Sci. **12:** 279. f. 3; Jennings Man. Mosses W. Pennsylvania *pl. 26;* Grout Mosses W. H-lens *pl. 14; Pl. 53 B.* (including varieties).
EXSICCATI:—Allen, Mosses Cascade Mts. 76; Aust. Musci Appal. 230; Frye, Bryo. Olympic Mts. 581; Grout, N. Am. Musci Perf. 265, Hand-lens mosses 9; Holz. Musci Acro Bor. Am. 72 (mixed with some *A.*

Macmillani), 72b; Macoun, Can. Musci 216, 563; Sull. & Lesq. Musci Bor. Am. 208; U. S. Soils Exped. Alaska 833; Drumm. Musc. Am. 67,285 those plants with large capsules.

On clayey soil. Newfoundland to Alaska, southward to California and South Carolina; Europe; Asia; Africa.

Plants from the Rocky Mts. and westward have larger leaf cells on the average than those of the Mississippi Valley and eastward, and often larger leaves. Plants in a region where the humidity is high most of the time seem to have larger leaves with larger leaf cells.

2a. Var. HAUSSKNECHTII (Jur. & Milde) **n. comb.**

Atrichum Haussknechtii Jur. & Milde, Verh. K. K. Zool.-Bot. Gesel. Wein 598. 1870.
Catharinea Haussknechtii Broth. Etud. Distrib. Mouss. Caucase 4. 1884.
Catharinea undulata var. *Haussknechtii* Dixon & Jam. Stud. Handb. Brit. Mosses (Ed. 1) 500. 1896.
Catharinea anomala Bryhn, Bot. Not. 157. 1886.
Catharinea lateralis Vaiz., Ann. Bot. **2:** 69. 1888.
Atrichum fertile Naw., Hedwigia **28:** 359. 1889.

Paroicous; antheridia central; their bracts suddenly acuminate, almost entire; archegonia a row external to the antheridia; *setae 2–6* from the same tip, persistent for a year or two, becoming apparently lateral through innovation from the antheridial tip. Type locality, European.

ILLUSTRATIONS:—Braithw. Brit. Moss Fl. **2:** *pl. 84A*.
EXSICCATI:—Macoun, Can. Musci 563a; Drumm. Musc. Am. 660.
Examined: Friday Harbor, Washington (Foster) 1904.
On soil. Nova Scotia; British Columbia; Washington; Europe; Asia.
The variety *Haussknechtii* is sometimes spelled with one "s" and at others with two. We do not have access to the original description and thus cannot say definitely which is correct.

2b. Var. SELWYNI (Aust.) **n. comb.**

Atrichum Selwyni Aust., Bot. Gaz. **2:** 95. 1877.
Catharinea Selwyni E. G. Brit., Bull. Torr. Club **16:** 110. 1889.
Catharinea rosulata Kindb. Eur. & N. Am. Bryin. 153. 1897.
Atrichum undulatum var. *altecristatum* Ren. & Card., Bot. Gaz. **15:** 58. 1890.

Lamellae 6–13 cells high. Type locality, West Coast of North America.

ILLUSTRATIONS:—Proc. Wash. Acad. Sci. **12:** 280. *f. 4*.
EXSICCATI:—Holz. Musci Acro Bor. Am. 373; Macoun, Can. Musci 6B, 216, 565; Sandberg, Pls. N. Idaho 1152.
On clayey soil in damp places, usually in mountains. Pennsylvania, Ohio, Michigan, Missouri, Kansas, Alberta, British Columbia, Montana, Idaho, Washington, Oregon, Colorado.
The variety like the species is variable in size of leaf and of leaf cell, but has higher lamellae. *A. Selwyni* Aust. is the vigorous plant of humid regions with higher lamellae, while *A. undulatum* var. *altecristatum* Ren. & Card. is the smaller form of less humid atmosphere with higher lamellae. Of the latter the material examined was not the type, but was Sandberg's Plants of N. Idaho, No. 1152, kindly lent by the University of Minnesota.

2c. Var. MINUS (Lam. & De Cand.) Web. & Mohr Bot. Tasch. 217. 1807.

Oligotrichum undulatum var. *minus* Lam. & De Cand. Fl. France (Ed. 3) **2:** 492. 1805.
Catharinea undulata var. *corsica* DeNot. Syll. Musc. 169. 1838.
Atrichum undulatum var. *abbreviatum* Schimp., B. S. G. Bryol. Eur. **21–22:** 8. 1844.
Catharinea undulata var. *abbreviata* Rabenh. Deutsch. Krypt. Fl. **23:** 233. 1848.
Catharinea callibryon var. *abbreviata* C. Muell. Syn. Musc. Frond. **1:** 193. 1849.
Catharinea undulata var. *allegheniensis* Jennings, Man. Mosses W. Pennsylvania 188. 1913.

Stem, leaves, seta and capsule all shorter than in the type; leaves narrower; lamellae obscuring 1/7–1/5 the leaf width about the middle. Type locality, European.

ILLUSTRATIONS:—Jennings, Man. Mosses W. Pennsylvania *pl. 27*.
EXSICCATI:—Holz., Musci Acro. Bor. Am. 529.
On rather dry soil. Pennsylvania; Kansas; Washington; Europe; Asia.

This seems to be merely a depauperate condition of the plants. However, there is an element of uncertainty, and thus it seems best to keep it separate. Examination of type material of Jennings' var. *allegheniensis* leaves no doubt in mind about its position as here given.

3. Atrichum angustatum (Brid.) B. S. G. Bryol. Eur. **21–22:** 9. *pl. 411.* 1844.

Polytrichum angustatum Brid. Sp. Musc. **1:** 79. 1806.
Polytrichum cylindricum Sw., Muehl. Cat. Pl. Am. Sept. 99. 1813.
Catharinea angustata Brid. Mant. Musc. **4:** 204. 1819.
Atrichum ligulatum Mitt., Kew Misc. **1857:** 262. 1857.
Catharinea xanthopelma C. Muell. Flora **56:** 482. 1873.
Atrichum xanthopelma Jaeg. & Sauerb. Adum. **1:** 705. 1873–1874.

Plants gregarious, dark olive-green, reddish brown when old, mediumly robust; stems mostly simple, from a branched rhizomatous base, erect, up to 5 cm. long, grooved, leafy above, bracteate below, with rhizoids from the lower part; leaves crispate when dry, erect to divergent at 45° when moist, grading to mere bracts below; larger leaves 3–4.5 mm. long, 600–750 μ wide at widest part, linear-lanceolate, bordered, toothed; *lamina* undulate, *with* few to many *teeth on the undulations* on the back, 1 cell thick; apex bluntish acute, ending in a tooth similar to those of the margin; marginal teeth along the upper 1/2–1/3, incrassate, from very few to most of them double; border extending from the base or near it to the tip or near it, 2 cells wide and 2 cells thick where well developed, of long narrow cells with thick walls; costa percurrent or barely vanishing, 73–103 μ wide about the middle, constituting 1/6–1/7 the median leaf width, or with its *lamellae obscuring* 1/3–1/4 *the median leaf width*, toothed on back near tip, lamellate on the ventral side; lamellae 4–7, on about the upper 3/4 of the leaf, *7–9 cells high* at their highest region, entire, composed of discontinuous longitudinal rows of cells, the marginal ones smooth like the others; leaf cells at 3/4 up in somewhat broken longitudinal rows, roundish-hexagonal, often longer transversely, 10–15 μ in longest diameter, smooth; cells near base midway between costa and margin rectangular, 1.5–2.5 times as long as wide; marginal basal cells narrower for their width; bracts of the lower part of the stem shorter than the leaves, wider for their length. Dioicous; calyptra about 4 mm. long, hispid at tip, split about 1/3 of its length; setae usually only 1 per tip, 1–2 cm. long, straight, smooth, hollow; capsule terete, almost erect, narrowly cylindrical, straight or nearly so, without stomata, gradually narrower at base; urn about 2.5–6 mm. long, 500–800 μ in diameter, 4–8 times as long as wide, its epidermal cells with incrassate longitudinal walls; lid hemispheric, rostrate, 2–2.5 mm. long, roughly half the length of the urn; peristome teeth 32, single, 145–300 μ long, 30–45 μ wide, 4.5–7 times as long as wide, from a basal membrane about 50 μ high; spores 10–14 μ, almost smooth. Type locality, European.

Illustrations:—B. S. G. Bryol. Eur. *pl. 411;* Hedw. Descrip. **1:** *pl. 17, f. 14–18;* Jennings, Man. Mosses W. Pennsylvania *pl. 27;* Proc. Wash. Acad. Sci. **12:** 278. *f. 2; Pl. 54A;* Drumm. Musc. Am. 68,285 (plants with smaller capsules).

Exsiccati:—Aust. Musci Appal. 228, 229; S. L. Clarke, N. Am. Mosses 440; Grout, Hand-lens Mosses 7, N. Am. Musci Perf. 20; Holz. Musci Acro. Bor. Am. 122, 430 (one of two packages examined); Macoun, Can. Musci 564; Small, Georgia Mosses 9557, 9564; Sull. & Lesq. Musci Bor. Am. 209. See MF I. 251

On sandy soil in shade. Newfoundland, Nova Scotia, New Brunswick, Ontario, Wisconsin and Minnesota, southward to Texas, Louisiana and Florida; Europe; Asia.

A. xanthopelma is a form found in the southeastern part of the U. S. and has fewer double teeth. It was described as having teeth single, but it is difficult to find a leaf without some double teeth, and there is no line of demarcation on that basis. The capsules average smaller, but there is again no definite separation. Its teeth are weaker in the more marked form. Single teeth in *Atrichum* are found at points where the margin is only one cell thick.

3a. Var. plurilamellatum (Jennings) **n. comb.**

Catharinaea plurilamellata Jennings, Man. Mosses W. Pennsylvania 191. *pl. 27.* 1913.

Leaves narrower above the sheath, the *lamellae obscuring* 1/2–2/3 *of the median leaf width;* lamellae *7–12, 8–14 cells high.* Type locality, Ohio Pyle, Fayette County, Pennsylvania (O. E. and Grace E. Jennings) September 10, 1905. (About lat. 39° 53′ N., long. 79° 29′ W.) *Pl. 54A. figs. 22-24.*

Illustrations:—Jennings *l. c.*
Examined:—Co-type material.
On shaded banks. Pennsylvania.

Papillose plants of this should be referred to *A. papillosum.* Possibly those not papillose should be referred to *A. angustatum,* but until we know more about the range and the limits of variation it seems best to keep it distinct as a variety.

4. Atrichum papillosum (Jennings) n. comb.

Catharinaea papillosa Jennings, Man. Mosses W. Pennsylvania 190. *pl. 27.* 1913.

Plants loosely caespitose, dark-green; stems simple or at the base sparsely branched, towards the base radiculose, erect, about 2 cm. high, chestnut-brown to purple; leaves crispate and circinate when dry, erect or erect-spreading when moist, gradually longer up the stem, grading into bracts below; the upper leaves tufted, oblong-linear, 3–5 mm. long, 700–1000 μ wide, bordered, toothed; lamina somewhat undulate, with some strong teeth on the undulations, 1 cell thick; apex obtuse to acute; border of elongate cells from near base, sometimes disappearing between the teeth near the tip, mostly 2–3 cells wide and 2 cells thick; marginal teeth in the upper 1/2–1/3 more or less double; costa percurrent, coarsely few-toothed on back near tip, constituting 1/6–1/4 the median width of the leaf, or with its *lamellae obscuring 1/5–1/3,* lamellate on the upper side; lamellae 4–8, mostly *6–14 cells high,* entire, not undulate, composed of broken longitudinal rows of cells minutely and sparsely papillose at least along the margin; *leaf cells* at 3/4 up *slightly minutely papillose* on both sides, often wider than long, 8–15 μ in longest diameter; those of the median region of the sheath 45–50 μ wide and 100–150 μ long. Dioicous, or rarely the archegonia on an innovation from an antheridial tip of the preceding year; antheridial bracts abruptly linear-acuminate from an ovate-orbicular concave base, about 2 mm. wide and 3 mm. long, canaliculate toward the apex, sparsely papillose; perichaetial leaves similar to the stem leaves; calyptra about 5 mm. long, narrowly cucullate, not extending to the base of the capsule, slightly hairy toward tip; setae 1 or rarely 2, erect, flexuous, often slightly twisted to the left, about 2 cm. long, smooth, chestnut-brown; *capsule* linear-cylindric, *3.5–6 mm. long,* 500–700 μ in diameter, erect-arcuate; urn tapering abruptly at the base, smooth, chestnut brown; epidermal cells of the urn rectangular, their lateral walls much incrassate, in a series of 5 or 6 cells under the mouth smaller, quadrate, darkly incrassate; peristome teeth 32, linear-oblong, about 200 μ high, in the median line reddish orange, towards the sides hyaline, in the margins a little dark and densely although minutely papillose; basal membrane about 100 μ high; spores 8–11 μ, smooth, somewhat orange; lid subulate from a hemispheric base, shining, dark chestnut-brown; its beak about 1.8 mm. long. Type locality, West end of Fern Hollow Bridge, Pittsburgh, Pennsylvania (Jennings) March 8, 1908.

Illustrations:—Jennings, *l. c.; Pl. 54B.*
Examined:—Co-type material.
On banks. Pennsylvania.
It differs from *A. angustatum* chiefly in that its leaves are finely papillose and the lamellae slightly higher. Only papillose plants should be referred here, since the lamellae alone are not sufficient to warrant a new species. The papillosity is very similar to that in *A. Macmillani* but is not figured by Jennings. See comments after *A. Macmillani.*

5. Atrichum Macmillani (Holz.) n. comb.

Catharinea Macmillani Holz., Minnesota Bot. Studies 3^2: 120. *pl. 19.* 1903; (sterile). Chamberlain, Rhodora 9: 99. *pl. 75.* 1907; (fertile).

Plants dull-olive, or when old reddish-green, brown below; stems from a rhizomatous base, simple or branched below, erect, up to 2.5 cm. long, with some rhizoids from the lower part; leaves crispate and somewhat spirally contorted when dry, erect-patent when moist, linear-oblong, grading into bracts below; larger leaves 2–3 mm. long, about 500 μ wide, bordered, toothed; lamina somewhat undulate in the upper third, with several rows of strong dorsal teeth on the undulations, 1 cell thick; apex acute, often ending in a tooth like the marginal ones; margin bordered with elongate cells from near the base, toothed in the upper half or third; border often evanescent between the teeth above, mostly 2 cells wide and 2 cells thick; teeth incrassate, about 1/3 of them double; costa percurrent, semiterete, constituting 1/6–1/5 the median width of the leaf, or with its *lamellae* 1/4–1/3, toothed on back near tip, lamellate on the upper side; lamellae 4–8, disappearing 1/5–1/4 up from the leaf base, *6–12 cells high,* entire or minutely crenulate, not undulate, composed of broken longitudinal rows of cells, the marginal cells with 2–3 small papillae but hardly otherwise thickened, *cells* at ¾ up round to hexagonal, often wider than long, 8–15 μ in longest diameter, usually *with 1–3 low papillae on the dorsal surface,* with fewer to almost none on the ventral; cells near leaf base midway between

costa and margin rectangular, 19–43 μ long, 12–17 μ wide, basal marginal cells narrower for their length. Dioicous; archegonia in the axils of the inmost leaves; calyptra cucullate, rough at apex, equaling the urn; setae 1 or rarely 2, 30–50 mm. long, terete, brownish; capsule cylindric; the *urn 1.5–3 mm. long*, 500–600 μ wide, erect, straight or slightly curved, smooth; its epidermal cells longitudinally incrassate, the upper 5–6 cells below the mouth with the transverse walls also incrassate; teeth 32, linear, 19–21 μ wide, 96–100 μ long, 4.5–5 times as long as wide, occasional ones double, acute, with some papillae, rough at margin, from a basal membrane half as long; spores 8–15 μ, smooth. Type locality, Ortonville, Minnesota.

Illustrations:—As mentioned under the name; *Pl. 54C.*

Exsiccati:—Holz. Musci Acro. Bor. Am. 72 (as *Catharinea undulata* has this intermingled as the smaller plants), 249, 430 (as *Catharinea xanthopelma*, although of two packages of this number examined one was correctly named, while the other was *A. Macmillani*), 528; Rapp, Florida Mosses 19.

Examined:—Winter Park, Florida 1936 and Hartsville, South Carolina 1931 (Grout).

On dry sterile soil. Maine to Minnesota, southward to Missouri and Florida.

This is not as distinctive a species as one might conclude from the description and figures, and thus has escaped recognition about as often as any, probably because the papillae are less easily seen than one might conclude from the figures. They are most easily seen with a magnification of 500 or more diameters in a cross section from the upper half of the leaf, and are much more abundant on the dorsal than on the ventral side. It is distinguished from *A. papillosum*, its nearest relative, by the sporophyte. *A. Macmillani* has a much shorter seta, and a shorter urn of the capsule as well as shorter teeth. However the lid and calyptra are of about the same length as in *A. papillosum*. The two are about equally papillose. Perhaps *A. Macmillani* is merely a depauperate form of *A. papillosum*, but the collections of both are too limited to enable one to reach a conclusion. For that reason they are kept separate.

2. OLIGOTRICHUM Lam. & De Cand. Fl. France (Ed. 3) **2**: 491. 1805.

Psilopilum Brid. Bryol. Univ. **2**: 95. 1827.

Plants green to yellowish-green, brownish when old, gregarious or in loose sods, often firm in texture; stems slender to stout, usually of medium height, arising from creeping subterranean rhizomes, scaly below, leafy above; central strand not polytrichoid, not sharply defined; rhizoids from base of stem; leaves more or less close, grading below into smaller and smaller scales; larger leaves more or less spreading from an erect sheath-like base, sometimes almost tubular at tip through the involute leaf margins, sometimes keeled, lanceolate to oblong or lingulate; dry leaves applied to the stem, sometimes slightly crispate, with apex curved toward the stem; *margin not bordered* with elongate cells; *lamina* not or little undulate, 1 cell thick, *rarely with a few teeth at back*, sometimes with dorsal and ventral lamellae; costa vanishing to excurrent as a tooth, lamellae sometimes present on dorsal side near apex and in some species extending down to the sheath-like base, always with lamellae on the ventral side; dorsal lamellae of costa straight, usually serrate and low, in most cases not extending very far down; ventral lamellae of costa wavy from side to side in most species, entire to crenulate, of smooth cells, the *marginal cells like the others;* leaf cells thick-walled, quadratic to roundish-hexagonal or wider than long in upper part, rectangular, the lower poor in chlorophyll. Dioicous; male inflorescence terminal, cup-like to saucer-shaped, innovating from the center; female inflorescence terminal; calyptra cucullate, with sparse erect hairs or rarely naked or matted hairy; setae solitary; *capsules* erect to inclined, regularly terete or slightly laterally compressed, ovoid to subcylindrical, straight to strongly arcuate, rather abruptly narrowed to the seta, *with stomata* at base; stomata very large, with 2–4 guard cells; epidermal cells of the urn smooth; spore sac separated from the wall all around by an air space containing filamentous tissue, outwardly terete, inwardly with 4 deep grooves and thus the thin columella apparently 4-winged; teeth of peristome usually unequal in size, uniformly light in color; lid readily falling off, conic, with the terminal projection varying from a mere point to a long thin beak.

There is no character which can be relied upon at present to distinguish *Oligotrichum* from *Psilopilum*. Among the species commonly referred to these two genera, the prime character upon which to base a subgrouping is the presence or absence of the peristome. However, the type species of the genus *Psilopilum* has a peristome, as does that of *Oligotrichum*.

Key.

Leaves coarsely toothed, soft, pliable; lamina as well as costa often with conspicuous lamellae on back.

Lamellae of the ventral side of the costa straight or nearly so, entire or nearly so; lamina with lamellae only near the tip or none at all ..... 1. *parallelum.*

Lamellae of the ventral side of the costa wavy from side to side, coarsely serrate; lamina with lamellae down to the sheath-like leaf base..... 2. *aligerum.*
Leaves rather finely toothed to entire, rather stiff and rigid; lamina rarely with some suggestions of lamellae on back, though nearly always present on back of costa.
Transverse walls of the marginal and submarginal cells approaching the margin at about right angles; leaf margin not hyaline..... 3. *hercynicum.*
Transverse walls of the marginal and submarginal cells approaching the margin diagonally forward, the marginal 1 or 2 cells hyaline at least in parts.
Leaves erose-dentate..... 4. *laevigatum.*
Leaves entire to finely dentate..... 4a. var. *cavifolium.*

1. OLIGOTRICHUM PARALLELUM (Mitt.) Kindb. Eur. & N. Am. Bryin. 156. 1897.

Atrichum parallelum Mitt. Jour. Linn. Soc. London **8:** 48. 1865.
Atrichum leiophyllum Kindb. Bull. Torr. Club **17:** 275. 1890.
Oligotrichum leiophyllum Kindb. Eur. & N. Am. Bryin. 156. 1897.

Plants loosely caespitose, dark-green; stems simple, short, erect, 1.5–4 cm. long, scaly below the leaves; rhizoids from lower part of stem only; lower scales of the stem about as wide as the stem, ovate, entire, acute, without lamellae; scales grading upward into the leaves; larger *leaves* spreading when moist, *crispate when dry*, oval to ligulate-oval, 3–4.2 mm. long, 1–1.5 mm. wide, not or little undulate, with lamellae on both sides on the costa; lamina with an occasional small lamella on the back and sometimes with a few tooth-like processes; margin serrate from tip to about the middle or more; *marginal teeth coarse, sharp*, the upper composed of 2–4 cells and grading into the smaller lower ones of not over 1 cell; apex acute; costa percurrent to excurrent as a tooth; *lamellae of ventral surface 4–6, not wavy from side to side*, up to 6–7 cells high, *entire*, their cells in distinct longitudinal rows, the marginal cells like the others; *dorsal lamellae 2–4, on costa near tip*, dentate above, crenate below; median leaf cells at 3/4 up roundish to angular, isodiametric or wider than long, not thick walled, 10–22 μ; those of the margin about the same or with somewhat thicker walls for a few rows; basal cells rectangular, 40–51 μ long, 10–21 μ wide. Inflorescences terminal; male plants smaller, the inflorescence cup-shaped, rejuvenating through the center; bracts ovate or obovate, some of them cuspidate, 1–1.5 mm. long; perichaetial leaves convolute at base, gradually narrowed, lanceolate; calyptra cucullate, with few erect hairs on upper half, with short papilliform hairs at tip; setae solitary smooth, brown, mostly slightly twisted to the right above, 2.5–3 cm. long; capsule subcylindric, only slightly ventricose below, slightly arcuate, verrucose; urn 4–5 mm. long, 1.1–1.3 mm. thick below, narrowed to about 0.9–1 mm. below mouth, with stomata near base; stomata cryptopore, with 2 guard cells, the slit rather narrow; epidermal cells of urn rectangular, 55–90 μ long, 13–26 μ wide; the first few cells below the mouth wider than long, grading into the normal ones; lid rostrate from a conic base, about 900 μ wide, the beak about 550 μ long; teeth 32, often showing tendency to divide, 150–190 μ long, 85–90 μ wide, rough but not or only very finely papillose on outer side, not papillose on inner side; basal membrane 150–160 μ high; spores 12–17 μ, brownish, smooth. Type locality, Grande Cote, Rocky Mountains (Drummond). Grande Cote is probably merely the general Pacific Coast region, the name Rocky Mountains being applied to the whole western cordillera.

ILLUSTRATIONS:—Jour. Linn. Soc. London **8:** *pl. 8;* Sull. Icones Musc. Suppl. *pl. 38;* Proc. Wash. Acad. Sci. **12:** 283. *f. 5; Pl. 55A.*

EXSICCATI:—Drumm. Musci Bor. Am. 286 (as *Polytrichum undulatum*); Holz. Musci Acro. Bor. Am. 199, 269, 658; Macoun, Can. Musci 568, 569 (as *Atrichum leiophyllum*); U. S. Soils Kelp Exped. Alaska 1227.

On rocks and soil in mountainous regions. Alaska to Washington; Norway.

O. parallelum is much more variable in its leaves than was supposed when it was described. The lamellae vary in height on the same plant and in different localities. The more lush it grows the more its leaves tend to elongate and thus approach the lingulate form. The teeth and lamellae on the lamina may or may not be present on leaves of the same plant. The longitudinal stripes on the lamina of *O. parallelum* mentioned by Kindberg in Eur. and N. Amer. Bryineae 156, are merely low lamellae and may or may not be present. Since these constitute the chief characters on which *O. leiophyllum* is based, it is a synonym of *O. parallelum*, as Cardot & Thériot decided (Proc. Wash. Acad. Sci. 4: 326, 1902). The lower portion of the leaf sometimes shows 1–2 rows of marginal cells up to twice as long as wide, while those just interior to them

may be wider than long. This suggestion of a border is the nearest approach to *Atrichum* of any North Amercian species of *Oligotrichum*.

2. Oligotrichum aligerum Mitt. Jour. Linn. Soc. London **8**: 48. *pl. 8*. 1865.

Plants loosely caespitose or gregarious, green, or brown to black when dry; stems simple, short, slender, erect, 1–3 cm. long, scaly below, leafy above; rhizoids rather abundant, at base of stem; lower scales of the stem about as wide as the stem, about as wide as long, ovate, entire, without lamellae, gradually grading into the leaves upward; the larger scales with lamellae on both sides of costa and lamina, with some teeth toward tip; larger *leaves* spreading or ascending when moist, *crispate when dry*, lanceolate from a sheath-like base, slightly curved, 2.5–4.5 mm. long, 0.6–1.2 mm. wide, not papillose, with lamellae on both sides on lamina and costa; margin erect or incurved in upper ⅔, serrulate from tip to about the middle; *marginal teeth small, distant, blunt*, nearly all of them composed of less than 1 cell which is sometimes slightly larger than the surrounding ones; apex acute to somewhat subulate; costa excurrent; *lamellae of ventral leaf surface 6–10*, specially *those on the costa wavy from side to side*, up to 5–7 cells high or those not on the costa lower, *distantly and bluntly serrulate*, extending down to the sheath, the marginal cells like the others except that the tooth cells are sometimes larger; ventral lamellae on the lamina mostly reduced to crests; *lamellae of the dorsal leaf surface 6–9*, straight or nearly so, up to 4–5 cells high, *extending nearly to leaf base*, coarsely serrate to the sheath; teeth distant, blunt, larger than those of the ventral lamellae and of the leaf margin, usually composed of about 1 whole cell which is often larger than the surrounding ones; median leaf cells at ¾ up roundish-quadrate or oval, rather thick walled, 7–12 μ, those of the margin about the same but often wider than long; cells near base rectangular, 13–35 μ long, 10–20 μ wide. Male plants about same size as the female, easily recognized by the wide bracts; antheridia among hair-like paraphyses; male tip proliferating through the center; male bracts ovate, brownish when old; female tip with few archegonia among hair-like paraphyses; perichaetial leaves more narrowed toward tip than the leaves; calyptra with few short erect hairs to ¾ down, the very tip prickly with papilliform hairs; setae solitary, smooth, often twisted to right above or sometimes to the left, 3–4 cm. long; capsules subcylindric, somewhat ventricose below, slightly arcuate, not papillose; urn 3–4.5 mm. long, 0.96–1.38 mm. thick below, narrowed to 545–770 μ slightly below the mouth, with stomata near base; stomata phaneropore, with 2 guard cells, the slit narrow; epidermal cells of urn rectangular or hexagonal, 1.5–3 times as long as wide, yellowish brown; the first few cells below the mouth of the urn wider than long, grading into those below, dark brown; lid about 1 mm. wide, depressed-conic, with beak about 1 mm. long; teeth 32, fairly regular, about 140 μ long and 70 μ wide, they and the basal membrane finely granulate, less so on the inner side; spores 8–10 μ, brownish, smooth. Type locality, Grande Cote, Rocky Mountains (Drummond). See type locality of *O. parallelum*.

Illustrations:—Jour. Linn. Soc. London **8**: *pl. 8;* Sull. Icones Musc. Suppl. *pl. 39;* Proc. Wash. Acad. Sci. **12**: 284. *f. 6; Pl. 56A*.

Exsiccati:—Grout, N. Am. Musci Per. 128; Holz. Musci Acro. Bor. Am. 199 (but of two packages of 199 examined one is labelled correctly, the other as *O. parallelum*), 657; Macoun, Can. Musci 77, 571; Taylor, Pls. B. C. 156 (with some *Pogonatum capillare*); U. S. Soils Kelp Exped. Alaska 996; Drumm. Musc. Am. 16. cf MFI 25 |

On clayey banks in mountains. Alaska to Oregon.

Sullivant, Icones Musc. Suppl. *pl. 39* is misleading in some points. His figure 5 leaves one in doubt as to which arm of the bifurcate margin is the ture leaf margin. From his figure 6 one concludes it is the lower because the upper does not reach the apex. Whether the areolation drawn beside his figure 6 is from the upper or the lower part of the bifurcate margin is not stated, but the teeth shown are more nearly those of the lower. Leaves examined under the microscope show clearly that the upper arm of the bifurcation is the margin; from this one is led to believe he has shown the areolation of the most lateral lamella on the under side. His figure 4 of the ventral side of the leaf also shows the dorsal arm of the bifurcate margin disappearing at tip, while in reality it is the margin at the tip, and therefore also downward.

3. Oligotrichum hercynicum (Hedw.) Lam. & DeCand. Fl. France (Ed. 3) **2**: 492. 1805.

Catharinea hercynica Ehrh. Beitr. **1**: 190. 1787.
Polytrichum hercynicum Hedw. Stirp. Crypt. **1**: 40. *pl. 15*. 1787; Sp. Musc. Frond. 94. 1801.
Catharinea sancta Brid. Mant. Musc. **4**: 203. 1819.
Catharinea hercynica var. *sancta* Brid. Bryol. Univ. **2**: 101. 1827.
Catharinea sudetica Presl., Brid. Bryol. Univ. **2**: 106. 1827.
Oligotrichum incurvum Lindb., Hartm. Skand. Fl. (Ed. 9) **2**: 45. 1864.

Oligotrichum hercynicum var. *latifolium* C. Muell. & Kindb., Macoun Cat. Can. Pls. **6:** 149. 1892. Not *O. incurvum* var. *latifolium* of Frye in Proc. Wash. Acad. Sci. **12:** 286. *f. 8 (1a–3a).* 1910.
Oligotrichum integrifolium Kindb. Rev. Bryol. **21:** 40. 1894.
Oligotrichum exiguum Stirt. Ann. Scot. Nat. Hist. **16:** 173. 1907.

Plants glaucous-green to yellowish-green, or when old reddish-brown, not shining, in loose sods; stems 2–3 cm. long, erect or nearly so, simple, angular; in cross section the cells toward the center smaller, slightly collenchymatous; central strand not polytrichoid, not clearly bounded; leaves scale-like at base of plant, gradually larger upward on stem, somewhat spreading when moist, when dry erect with the tips curved toward the stem, *firm, hardly crispate,* not undulate, the larger ones linear-lanceolate from an oblong sheathing base, up to 4.5 mm. long and 2.5 mm. wide; apex bluntly pointed; *margin involute above* so the leaves are almost tubular to hardly so at all, not lighter in color; *with small distant teeth,* these sometimes quite coarse toward apex; costa well developed, its back with 2–5 rudimentary lamellae with coarse and rather distant serrations; *lamellae of upper side* of leaf *8–12,* all on the costa, occupying about half the leaf width in the upper part, *undulate from side to side, 6–12 cells high,* the margin crenulate; their marginal cells similar to the others, not papillose; lamina 1 cell thick, mostly with some short lamella-like crenulations on the back, or quite smooth; leaf cells thick walled; *at ¾ up* quadratic or hexagonal, often wider than long, 10–15 μ, *at the margin the transverse walls approaching the margin almost at right angles;* cells of the base rectangular, 2–4 times as long as wide, with little chlorophyll; cuticle finely longitudinally striate. Male plants shorter; male inflorescence discoid, rejuvenating from the center; inner male bracts broadly obovate, with acute point, without lamellae; paraphyses filiform, or some longer and spatulate; antheridia curved; female inflorescence with short filiform paraphyses; vaginula clavate-cylindric; ocrea none; calyptra cucullate, reaching the middle of the urn, with scattered erect hairs; seta 1–3 cm. long, thick, reddish-yellow; toward upper end somewhat grooved, solid, twisted to the right; toward base terete, with cylindrical hollow; axis of seta a small central strand surrounded by a layer of large cells; central hollow surrounded by large radially elongated cells; cortical cells 2 layers, small, colored, thick-walled; foot hook-like at tip; capsule erect, or when empty inclined, ovate-cylindric, 3–4 mm. long, 1.5 mm. thick, straight, thin-walled, brownish, when dry somewhat plicate and contracted below the mouth, narrowed below to the seta, with stomata at base; stomata numerous, large, oval, 70–90 μ, of 2 or rarely 4 guard cells, phaneropore; their pores long, narrow; lid shortly beaked or merely pointed from a conic base, falling with the calyptra; beak about 275 μ long; columella 4-winged, epidermis of capsule smooth; its cells thin walled, longer than wide, 4–6-sided; those about the mouth for 5–8 transverse rows red, the upper disintegrating into single cells; peristome teeth and basal membrane whitish, delicate, not papillose; teeth 32–50, the excess over 32 arising from irregular longitudinal division, rather short but quite variable in length; basal membrane papillose, delicate, about 40 μ high, unequal; spores 10–15 μ, yellowish, smooth. Type locality, "Am Rehberg zwischen Andreasberg und Oderbrueck," Germany (Ehrhardt) 1780.

Illustrations:—Hedw. Stirp. Crypt. **1:** *pl. 15;* B. S. G. Bryol. Eur. *pl. 413;* Braithw. Brit. Moss Fl. **1:** *pl. 5D;* Husnot Musc. Gall. *pl. 77D;* Limpr. Laubm. **2:** *f. 320;* Proc. Wash. Acad. Sci. **12:** 285. *f. 7 and 8 (1–3);* Dixon & Jam. Stud. Handb. Brit. Mosses (Ed. 3) *pl. 5C;* Moenkem. Laubm. Eur. *f. 225a; Pl. 55B.*

Exsiccati:—Frye, Bryo. Olympic Mts. 526; Holz. Musci Acro. Bor. Am. 542; Macoun, Can. Musci 661 (from Rogers Pass July 31, 1890, the type of *O. hercynicum* var. *latifolium*), also 577 as *Pogonatum dentatum* of same place and date.

Examined:—Sandon, British Columbia (*F. A. MacFadden 240*). Mt. Rainier, Washington (*O. D. Allen 15*).

On moist soil or on bare soil slopes in mountainous regions. Greenland; Alaska to Washington; Asia; Faroe Islands; Europe.

Much of the European material and more of the American examined has teeth on the leaves less distinct than figured in Dixon & Jameson's Student's Handbook of British Mosses. The var. *laxa* of Europe shows coarser serrations as a rule. It seems likely that under hard conditions the leaves have fewer and less distinct marginal teeth, the leaves remain shorter, and the dorsal lamellae are often not so well developed. However, no natural line of cleavage presents itself, and thus the var. *latifolium* C. Muell. & Kindb. is considered merely a form.

4. Oligotrichum laevigatum (Wahlenb.) B. S. G. Bryol. Eur. **21–22:** *pl. 414.* 1844.

Polytrichum glabratum Wahlenb., Web. & Mohr Ind. Mus. Pl. Crypt. 1803; *nomen nudum.*
Polytrichum laevigatum Wahlenb. Fl. Lapp. 349. *pl. 22.* 1812.
Catharinea glabrata Hook. Tour in Iceland (Ed. 2) 1813.

Polytrichum marginatum Schwaegr. Suppl. 1^2: 329. 1816.
Catharinea laevigata Brid. Mant. Musc. **4**: 162. 1819.
Psilopilum arcticum Brid. Bryol. Univ. **2**: 95. 1827.
Oligotrichum glabratum Lindb. Musc. Scand. 12. 1879.
Psilopilum laevigatum Limpr. Laubm. **2**: 602. 1895.
Psilopilum glabratum Holz., Bryol. **5**: 80. 1902.

Plants gregarious or in loose sods, green to brownish; stems up to 2 cm. long; *leaves* appressed when dry, *not crispate,* ovate or obovate to long-elliptic, up to 4 mm. long and about 1 mm. wide; apex blunt, almost cucullate; *margin broadly incurved above and in portions hyaline for 1 to several cells in width;* costa 120–180 μ wide, percurrent to vanishing close to the tip; *ventral lamellae 5–14, wavy from side to side,* coarsely and irregularly toothed, *8–11 cells high* in highest part, the marginal cells like the others; median leaf cells at ¾ up 16–24 μ, thin walled; *those at margin* a few rows narrower and *somewhat elongate, their walls approaching the margin diagonally forward;* basal leaf cells 3–4 times as long as wide. Male inflorescence cup-shaped; perichaetial leaves 3–4.5 cm. long, lanceolate from a sheathing base; calyptra cucullate, small, extending ¼–⅓ down the urn; seta 1–2 cm. long, thin, sinuose when dry, reddish; capsule strongly curved, rusty-red, with age becoming blackish-brown, with rather small mouth, with stomata at base; stomata superficial, 60–70 μ; epidermal cells of the urn wider than long below the mouth; those lower down rectangular, about 2–3 times as long as wide on the convex side of the urn, on the concave side some of them shorter and even wider than long; teeth unequal in length, 1.5–2.5 times as long as wide. Type locality, Northern Europe.

Illustrations:—Proc. Wash. Acad. Sci. **12**: 289. *f. 9;* Engler & Prantl Nat. Pfl.-Fam. (Ed. 2) **11**: *778, A–J; Pl. 56B.*
Exsiccati:—Macoun, Can. Musci 574.
Examined:—Claushavn, northern Greenland (Berggren) 1870; Labrador (Breutel) 1851.
On peaty or sandy soil in mountains. Greenland; Arctic America; Asia; Europe.

4a. Var. cavifolium (Wils.) **n. comb.**

Polytrichum laevigatum Hook. & Arn., Bot. Capt. Beechey's Voyage 133. 1841. Not of Wahlenb. Fl. Lapp. 349. *pl. 22.* 1812.
Polytrichum cavifolium Wils., Seems Bot. Voyage Harald 44. 1852.
Catharinea tschuctschica C. Muell., Hall in Bot. Centralb. **16**: 93. 1883.
Oligotrichum tschuctschicum Lindb. & Arn. Köngl. Svenska Vetens.-Akad. Handl. 23^{10}: 10. 1890.
Oligotrichum incurvum var. *latifolium* Frye, Proc. Wash. Acad. Sci. **12**: 286. *f. 8a–8c.* 1910. Not *O. hercynicum* var. *latifolium* Kindb., Macoun Cat. Can. Pls. **6**: 149. 1892.
Psilopilum tschuctschicum Paris, Index Bryol. (Ed. 1) 1039. 1897.
Psilopilum cavifolium Hagen, Bryol. **19**: 70. 1916.

Leaves not greatly crowded; lamina smooth; apex short-incurved, acute; *margin quite entire;* costa smooth on back, about 120 μ wide, with a strong dorsal stereid band; lamellae entire, leaf cells at ¾ up rather thick walled; those of the base rectangular, thin walled. Perichaetial leaves gradually narrowed to lanceolate from an oval base, about 3 mm. long; capsule slightly curved. Type locality, Kotzebue Sound, Alaska. (About lat. 67° N., long. 163° W.)

Illustrations:—Bryol. **5**: *pl. 8;* Proc. Wash. Acad. Sci. **12**: 287. *f. 8a; Pl. 56B. figs. 12-14.*
Examined:—St. Lawrence Island, Alaska (Macoun) Aug. 15, 1891.
On soil. Greenland, Yukon, Alaska, N. Europe; N. Asia; Iceland.
The variety *cavifolium* represents the extremely reduced form. In the extreme it has leaves entire, short, and without dorsal lamellae or crests. But the upper leaves often show abortive teeth or even fairly distinct lamellae, or both.
O. cavifolium var. *anomalum* Hag. and *O. laevigatum* var. *laxirete* C. Jens., from Greenland, seem to fall here, but we have not seen the plants.

3. LYELLIA R. Br. Trans. Linn. Soc. **12**: 561. 1818.

Philocrya Hag. & Jens., Medd. om Groenland **15**: 388. 1897.
Bartramiopsis Kindb., Rev. Bryol. **21**: 35. 1894.

Plant stiff, gregarious, brownish-green; stems with polytrichoid central strand, simple, firm, erect, free from leaves to well up, leafy above; rhizoids near base of stem; leaves spreading, crispate when dry,

with a sheath-like base, not bordered with long cells; sheath wide, membranous; *lamina 2 cells thick for most of its area*, not undulate, margin serrate at least in upper part; costa percurrent or excurrent, toothed on back above, lamellose on ventral side; lamellae few to numerous, entire to crenulate or serrate. Dioicous; male inflorescence saucer-shaped, innovating from the center; *calyptra* cucullate, *smooth;* seta thick, stiff, solitary; capsules erect or suberect, becoming almost horizontal in some species, irregularly or regularly ovoid to oblong; neck hardly differentiated, *with stomata; peristome wanting;* lid rostrate from a conic base.

KEY

Lamellae 5–8, sharply serrate; leaves with cilia where sheath narrows to blade; costa smooth on back ..... *1. Lescurii.*
Lamellae 24–30, entire to crenulate; leaves without cilia; costa toothed on back toward tip. *2. aspera.*

1. LYELLIA LESCURII (James) n. comb.

Atrichum Lescurii James, Bull. Torr. Club **6**: 33. 1879.
Bartramiopsis Lescurii Kindb. Rev. Bryol. **21**: 35. 1894.
Bartramiopsis sitkana Kindb. Rev. Bryol. **21**: 35. 1894.
Oligotrichum Lescurii Mitt. Trans. Linn. Soc. **1891**: 191. 1891.

Plants dark-green to brown or nearly black when dry, loosely caespitose or gregarious; stems simple or rarely forked, 2–8 cm. long, slender but rather stiff, sometimes long-naked below, scaly below the leaves, loosely foliate above; rhizoids from basal part of stem; leaves incurved-crispate when dry, erect-spreading when moist, linear-lanceolate, or when dry almost tubular, concave, somewhat sheath-like at base, up to 5 mm. long; apex acuminate; *margin densely and sharply serrate*, plane when wet, not bordered with long cells, in most parts 2 cells thick, entire from widest part down, *ciliate where basal part narrows upward;* these cilia 3–5 on each side, composed of a single row of elongate cells; teeth composed of several to a dozen cells, coarse; lamina not undulate, without dorsal teeth, in most of its area 2 cells thick, often 1 cell thick toward margin, unistratose regions considerably scattered; *costa* percurrent, rather wide, *smooth on back*, lamellose on upper side; leaf cells at ¾ up nearly roundish-hexagonal, obscure, thick walled, about 8 μ; basal leaf cells rectangular, thin walled, about 4–6 times as long as wide; *lamellae 5–8*, coarsely serrate, 5–8 cells high. Dioicous; male inflorescence saucer-shaped; rejuvenating through the center; calyptra glabrous, cucullate, small, shortly acuminate, covering only the lid; seta solitary, short, thick, 8–12 mm. long, undulate, reddish; capsule erect, regular, cylindrical-ovate, short; urn when empty enlarged at mouth and turbinate; neck hardly differentiated, with stomata; stomata large, with 2 guard cells; epidermis of urn smooth; peristome none; lid long-rostrate from a conic base; spores oval to somewhat angular, 12–16 μ. Type locality, Alaska (A. Kellogg).

ILLUSTRATIONS:—Engler & Prantl. Nat. Pfl.-Fam. (Ed. 2) **11**: *f. 779 L–R;* Proc. Wash. Acad. Sci. **4**: *pl. 21, f. 2, a–l*, also **12**: 291. *f. 10;* Jour. Bot. **39**: 341. *f. 14–15; Pl. 57A.*
EXSICCATI:—Holz. Musci Acro. Bor. Am. 372, 374; U. S. Soils Kelp Exped. Alaska 944 from Egg Harbor and 983 from Port Malmsbury, also 1100 from Swanson, British Columbia.
Examined:—Alaska: Wrangell (Engstrom) 1905; Yes Bay (Thomas Howell) 1895.
On soil in rather damp situations. Alaska; British Columbia; Kamchatka; Japan.

2. LYELLIA ASPERA (Hag. & Jens.) n. comb.

Philocrya aspera Hag. & Jens. Medd. om Groenland **15**: 388–391. *f. 1–9*, 1897.

Plants gregarious, brownish, dull in luster; stems simple, 3.5–4 cm. long, chestnut brown, the lower third scaly or bare, rather suddenly leafy above, about 550 μ thick above; rhizoids on lower part of stem, comparatively few; leaves spreading from a sheathing base when damp, imbricate and crispate at tip when dry, about 8 mm. long, lanceolate from a sheathing base; sheath yellowish, not completely covering the stem, 1.9–2 mm. long, about 1.6 mm. wide, mostly 1 cell thick; costa narrow, 400 μ wide at base, percurrent or excurrent with a few rows of teeth on back near apex; lamina mostly of 1 layer of cells in the marginal region; apex blunt; margin somewhat erect, *entire below, gradually toothed upward, the teeth in pairs near the tip;* ventral layer of leaf cells higher than wide in cross section of leaf, turgid-mamillate, moderately thick walled; dorsal layer of leaf cells isodiametric, about 7 μ, with thicker outer walls; *lamellae 24–33*, 5–15 cells high, 1 cell or here and there 2 cells thick, their marginal cells like the others or somewhat higher and scarcely

thicker walled; their margins entire or crenulate. Reproduction unknown. Type locality, at about 1000 meters, Scoresby Sound, Greenland (N. Hartz) May 12, 1892. (About lat. 71° N., long. 60° W.) Known only from the type collection.

ILLUSTRATIONS:—Hag. & Jens. *l. c.; Pl. 57B.*
We have not seen the material; but the gametophyte is fairly well figured, and the distinctions are of specific rather than generic importance.

4. POLYTRICHADELPHUS Mitt. Jour. Linn. Soc. London **8**: 49. 1865.

Plants vigorous, stiff, firm, forming loose sods, green to bluish-green, becoming reddish-brown when old; stem with a polytrichoid strand, from a subterranean rhizome, densely leafy, simple to rather fasciculately branched; leaves grading into bracts below on the stem; the larger leaves erect to spreading when moist, more or less canaliculate and appressed when dry, lanceolate from a sheathing base, with lamellae on the ventral side; margin serrate in upper part; costa with none to few small teeth on back near tip, excurrent as a red point; lamellae numerous, straight; their marginal cells usually larger than the others, somewhat ovate; cells of the median region of the sheath without chlorophyll, rectangular to linear; cells of the limb squarish to rectangular, thick walled. Dioicous; male inflorescence somewhat cup-shaped, rejuvenating from the center; *calyptra* cucullate, *from smooth to somewhat hairy; the hairs not very long*, scattered or more abundant near the tip; setae 1–2 from a tip, mediumly to quite long, stiff; capsule inclined, horizontal when old, oblong or ovate, 2 or 4 angled, *with numerous stomata*, the hypophysis not clearly constricted from the urn; epidermal cells of the capsule without papillae; sporogenous tissue with filamentous tissue both outwardly and inwardly; lid more or less beaked from a conic base; teeth 64.

1. POLYTRICHADELPHUS LYALLII Mitt. Jour. Linn. Soc. London **8**: 49. *pl. 8.* 1865.

Oligotrichum Lyallii Lindb. Not. pro Fauna Fl. Fenn. **6**: 102. 1868.
Polytrichum angustidens Lindb. Bot. Centralb. **84**: 338. *pl. 4. f. 10 a–i.* 1900.

Plants in loose tufts or sods, coarse, rigid, small to large; stems 6–50 mm. long, simple or the larger commonly fastigiately branched below, scaly at base, rhizoidous only at base; bracts or scales of stem with sheathing base, about 4 mm. or less long, 2 mm. or less wide, the sheathing base constituting almost all of the limb; leaves lanceolate from a sheathing base, spreading when moist, erect when dry; their sheaths oblong, erect, about 1.8 mm. or less long, shining when dry; the limb up to 10 mm. long; apex gradually narrowed, acute; margin of the limb plane below, upward gradually erect, near the tip erect or sometimes slightly incurved, serrate, the teeth mostly spinose; costa excurrent as an awn, occupying only the central part of the sheath and smooth or slightly denticulate on back near the tip; awn reddish, short, dentate; in cross section of the costa the dorsal bundle of stereids thick and continuous, the ventral ones interrupted and not well developed, the dorsal cells somewhat larger and incrassate on their surface side; lamellae about 46, straight, of one layer of cells, 4–6 cells high, commonly 70–100 μ high, entire; their marginal cells a little larger than the others, broadly oblong, *the outer wall crescentically thickened and roughened by longitudinally elongate shallow pits;* median cells of the leaf sheath 14–18 μ wide, 40–100 μ long; cells of unistratose leaf margin at ¾ up isodiametric or some slightly longer than wide, somewhat thick-walled, 12–15 μ in longest diameter. Dioicous; male plants smaller, the antheridia at the tip; inner perichaetial leaves with longer sheath and shorter limb than the foliage leaves; calyptra cucullate, widely split to near the tip, covering but little of the capsule, fugaceous, *with from few hairs to quite hairy but not densely so;* its hairs erect and descending, irregularly branched or unbranched, not papillose, appressed or at maturity loosely spreading; seta solitary, terminal, elongate, 4–6 cm. long and about 0.5 mm. thick, flexuose, yellowish to brownish or reddish when old; capsule slightly inclined at time when calyptra falls, nearly terete but with 4 longitudinal ridges unequally distributed in the circumference; mature capsules much inclined to nearly horizontal; urn about 2.5 times as long as wide, and about 5.7 mm. long and 2.3 mm. wide below, contracted just below the mouth to about 1.5 mm., ventricose, 2-ridged on the upper side with the area between the ridges sunken, less distinctly 2-ridged on the lower side with the area between the ridges sunken toward the mouth and swollen toward the base; base irregularly rounded; epidermal cells of capsule hexagonal, with a small surface thin spot; hypophysis constricted from the capsule, distinct, rugose, short, with stomata; spore tissue with filamentous tissue exterior to it; teeth 64, narrow, about 7 cells wide at base, pale, acuminate, papillose, about 35 μ wide and 200 μ long, the basal membrane about 100 μ high; lid conic, rostrate,

oblique, about 2.2 mm. long including the beak; beak subulate, curved; spores 8.8–12 μ, smooth. Type locality, in swampy places on the east side of the Cascade Mountains, British Columbia, at an elevation of 7000 feet, July, 1860 (Lyall). Probably it was very close to the northern boundary of the U. S. since he was a member of the party surveying this.

ILLUSTRATIONS:—Jour. Linn. Soc. London **8:** *pl. 8;* Bryol. **35:** 37. *pl. 4;* Sull. Icones Musc. Suppl. *pl. 40;* Bot. Centralb. **84:** 338. *pl. 4. f. 10a–10i;* Proc. Wash. Acad. Sci. **12:** 293. *f. 11; Pl. 58A.*

EXSICCATI:—Baker, Pls. Nevada 1492, Pls. Colorado 122 (as *Polytrichum alpinum* var., determined by N. C. Kindberg); S. L. Clarke, Mosses Colorado 33 and 34 (both as *Polytrichum gracile*); Frye, Bryo. Olympic Mts. 469, 483, 564, 573, 624; Holz. Musci Acro. Bor. Am. 225 (as *Polytrichum gracile*), 375, 445 (as *Polytrichum angustidens*); Leiberg, W. Am. Mosses 73 (as *Oligotrichum Lyallii*); Porter, Bryo. Central Rocky Mts. 2082, Wyoming Mosses 625; Sandberg, Pls. N. Idaho 1121 (as *Polytrichum angustidens*); U. Wyo., Pls. Colorado 1751 (as *Polytrichum gracile*).

On various substrata, but mostly on damp soil at 3000–7000 feet altitude. Montana, Idaho and British Columbia, southward to California, Utah, Colorado and Arizona (Wooton).

As stated by Schenk & Frye, Bryologist **35:** 33–38, *pl. 4*, 1932, this has a much more hairy calyptra than Sull. Icones Musc. Suppl. 56, *pl. 40*, 1874, would lead one to suppose. The characteristic brownish hairs of *Polytrichum* are present but not so abundant as in the other species of *Polytrichum.* The calyptra is smaller and falls off easily. It is therefore rarely present in packets of material with good capsules. In herbaria one finds it more often mistaken for *Polytrichum gracile* than any other moss. In the field, I believe most bryologists would call it a *Polytrichum*, even with the mature calyptra present on the then terete green capsule. The marginal cells of the lamellae are, however, more nearly like those of *Pogonatum alpinum*, although very indistinctly papillose to quite smooth.

5. POGONATUM Beauv. Prodr. 84. 1805.

Polytrichum Hedw. Sp. Musc. Frond. 88. 1801, in part.
Polytrichum section *Catharinella* C. Muell. Syn. Musc. Frond. **1:** 213. 1849.
Catharinella Kindb. Rev. Bryol. **21:** 35. 1894.

Plants in rather loose sods, dull-green becoming brownish with age, stiff; stems with central strand composed of two kinds of cells, stiff, scaly below, leafy above; leaves grading into the basal scales; larger leaves erect to spreading when moist, crispate or curved when dry, sometimes lanceolate to almost linear from a sheathing base, the sheath 1 cell thick except for the costa; margin of the limb entire to sharply and coarsely toothed, the unistratose portion 2–8 cells wide; costa indefinitely wide in the limb, percurrent or excurrent, usually toothed on back near tip, with lamellae on upper side except in some tropical species. Dioicous; male infloresecence cup-shaped to bud-like, commonly innovating through the tip; *calyptra densely hairy* so that its body is hidden, cucullate, the hairs not papillose; seta elongate; *capsule terete*, sometimes striate, with or without stomata, *hypophysis from slightly constricted to none;* epidermal cells of the urn often papillose to mammillate; teeth of the peristome 32 or these in various stages of doubling, of whole thick-walled cells; lid conic or depressed-conic, rostrate.

KEY.

A. Leaves thin, quite crispate when dry, coarsely toothed; lamellae 20–40 ..... *3. contortum.*
AA. Leaves thick, stiff, little or not crispate when dry.
  B. Lamellae 10–15; protoma persistent.
    C. Leaves toothed ..... *1. pensilvanicum.*
    CC. Leaves entire ..... *1a.* var. *Torreyanum.*
  BB. Lamellae 20–70.
    D. Leaves entire; marginal cells of the lamellae usually like the others, their walls not to little thicker; protonema persistent ..... *2. brachyphyllum.*
    DD. Leaves toothed; marginal cells of the lamellae usually unlike the others, their walls thicker.
      E. Teeth of the peristome 32; capsule without stomata, papillose.
        F. End cells of the lamellae flat-topped in cross section, the cell-hollow transversely rectangular ..... *5. capillare.*
        FF. End cells of the lamellae rounded in cross section, the cell-hollow vertically elliptical ..... *4. urnigerum.*

EE. Teeth of the peristome 40–64; capsule with stomata, not papillose; in cross section the hollow of the end cells of the lamellae pear-shaped. (*P. alpinum* and varieties).

G. Teeth of the leaves coarse.

1H. Leaves 4–8 mm. long; urn of capsule 1.8–4 mm. long, 2–3.5 times as long as thick; stems simple or with few branches..... *6d.* var. *brevifolium.*

2H. Leaves 7–8 mm. long; urn of capsule 4–5 mm. long, 3–5 times as long as thick; stems simple or with few branches..... *6b.* var. *arcticum.*

3H. Leaves 9–11 mm. long; urn of capsule 4–5 mm. long, 2–3 times as long as thick; stems much branched..... *6. alpinum* (typical).

4H. Leaves 12–14 mm. long; urn of capsule 5–6 mm. long, 3–4 times as long as thick; stems rarely branched..... *6a.* var. *Macounii.*

GG. Teeth of the leaves very low or almost none..... *6c.* var. *septentrionale.*

1. POGONATUM PENSILVANICUM (Hedw.) Paris, Index Bryol. (Ed. 1) 985. 1897.

Polytrichum tenue Menz. Trans. Linn. Soc. **4:** 68. 1798.
Polytrichum pensilvanicum Hedw. Sp. Musc. Frond. 96. *pl. 21. f. 1–6.* 1801.
Pogonatum brevicaule Beauv. Prodr. 84. 1805.
Pogonatum tenue Rau & Hervey, Cat. N. Am. Musci. 30. 1880. Taunton, N. J. Also E. G. Brit., Observer **5:** 120. 1894, and Mem. Torr. Club **4:** 172. 1894.

Plants gregarious, forming thin sods, greenish to brown; *stems* short, usually *1–2–8 mm. long*, unbranched, usually with few normal leaves between basal bracts and perichaetial leaves; rhizoidous only at base; leaves ascending when moist, erect when dry, lanceolate-subulate from a sheath-like base, the lower grading to ovate, 3–4 mm. long, the limb about 280 μ wide; sheath-like base large, distinct, about half the leaf length; apex long-acuminate, serrulate; *margin serrate in the upper half*, plane to erect; some of the teeth spinose; costa percurrent, smooth on back or somewhat toothed; *lamellae 10–15*, 4–6 cells high, crenulate toward leaf tip; their *marginal cells smooth*, differing little from the others, some longer and projecting somewhat above the others; cells of median region of leaf sheath rectangular, 50–115 μ long, 10–18 μ wide; cells of leaf at ¾ up thick walled, roundish or squarish to oval or rectangular, 10–20 μ in longest diameter. Dioicous; male plants intermingled with the female ones, shorter; male bracts erect-squarrose, imbricate, broadly obcordate; costa of male bract thick, excurrent into an inflated mucronate point; perichaetial leaves longer than the foliage leaves, up to 6 mm. long, the limb arista-like; calyptra extending well below the capsule, light yellow, very hairy; seta 1–2.5 cm. long, solitary, slender, smooth, yellowish to reddish; capsule erect or slightly inclined, terete, symmetric, yellowish to reddish; urn cylindric, about 4 mm. long and 800 μ wide, very little or not constricted below mouth, minutely mamillose with bulging cells; hypophysis separated by a slight constriction; lid about ⅙–⅕ as long as the urn, shortly conic; beak 1–3 times as long as the body of the lid, slightly curved; epidermal cells of the capsule roundish to oval, mostly 1–3 times as long as wide, thick walled, without a central thin spot; stomata none; spore tissue not ridged on outside, with loosely filamentous tissue only exterior to it; basal membrane about 50 μ high; teeth 32, about equal, about 200 μ long and 50–70 μ wide; spores 8–12 μ, smooth, yellowish brown. Type locality, Near Lancaster, Pennsylvania.

ILLUSTRATIONS:—Hedw. Sp. Musc. Frond. *pl. 21;* Jennings Man. Mosses W. Pennsylvania *pl. 28;* Sull. Icones Musc. *pl. 47;* Engler & Prantl Nat. Pfl.-Fam. (Ed. 2) **11:** *f. 782, A–G;* Schwaegr. Suppl. **2** (2)**:** *pl. 156* in part; Grout, Mosses W. H-lens, *f. 11; Pl. 58B.*

EXSICCATI:—Aust. Musci Appal. 232, 233; E. G. Britton, N. Am. Mosses 489; Grout, N. Am. Musci Perf. 2 (with some sterile *Atrichum angustatum* intermingled), 123 Hand-lens Mosses 12; Holz., Musci Acro. Bor. Am. 123; Macoun, Can. Musci 377 (as *Pogonatum capillare*) 575; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 210; Drumm. Musc. Am. 70. GH MF I 251

On moist clay banks. Newfoundland to Ontario and southward to Louisiana, Alabama and Georgia; S. America.

We use the original spelling by Hedwig, and followed by Bridel in Bryol. Univ. **2:** 114, 743, 1827. C. Mueller in Syn. Musc. Frond. **1:** 205, 1849, uses *pensylvanicum*, which is probably due to the somewhat interchangeable letters *i* and *y* in the German language. The earliest use of the spelling *pennsylvanicum* of which we are aware was by Sullivant in Icones Muscorum 75, 1864.

1a. Var. TORREYANUM (Brid.) Paris, Index Bryol. (Ed. 1) 985. 1897.

Pogonatum brevicaule var. *Torreyanum* Brid. Bryol. Univ. **2**: 115. 1827.
Polytrichum pensilvanicum var. *Torreyanum* C. Muell. Syn. Musc. Frond. **1**: 205. 1849.

Plants more slender; leaves pale-green, somewhat hyaline, long subulate, apex incurved, *margin entire;* seta shorter, slightly reddish. Type locality, Massachusetts (Torrey).

On clay bank. Known only from the original collection.

We have seen no specimens of this, but there are no characteristics unless it be the entire apex which would constitute a varietal separation. The lower bract-like leaves of *P. pensilvanicum* are, however, entire and often also some of the leaves. We consider this probably the extreme form in reduction of marginal teeth.

2. POGONATUM BRACHYPHYLLUM (Rich.) Beauv. Prodr. 84. 1805.

Polytrichum brachyphyllum Rich., Michx. Fl. Am. Bor. **2**: 225. 1803.
Pogonatum vaginans Brid. Sp. Musc. **1**: 68. 1806.

Plants gregarious, forming rather dense sods, olive-green to dark-brown; stems 2–3 cm. long, simple, rigid; rhizoidous only at base; leaves 2–3 times as long as the stem, spreading when moist, erect or the tips incurved when dry, broadly lanceolate from a wide and somewhat sheathing base, 1–3 mm. long; apex bluntly acute; *margin entire*, plane; costa percurrent, smooth on back; *lamellae 25–35*, entire or very finely sinuate by bulging cells, 7–10 cells high, in lateral view all the cells rather thick walled; in cross section the *marginal cells* roundish to oval, smooth, *about the same as the others*, their wall about the same thickness as the others *or slightly thicker and somewhat brownish;* cells of the leaf base rectangular to hexagonal, in the middle part of the sheath 3–4 times as long as wide, 40–85 μ long, 10–17 μ wide, rather thin walled; cells at ¾ up nearly isodiametric, thick walled, rounded to oval, 9–17 μ in longest diameter. Dioicous; male plants smaller; calyptra reaching about ⅔ down the capsule, dirty brown; seta solitary, 1.5–2 cm. long, solid, reddish, twisted to the right; capsule terete but slightly gibbous, ovate, slightly rough from the round bulging of the epidermal cells, yellowish brown; urn obscurely plicate when dry through the caving in of its sides; gradually narrowed to the seta; lid convex-conical, obtusely apiculate, about ⅖ the length of the urn; teeth 32, equal, about 300 μ long, about 4 times as long as wide; basal membrane about 40 μ high; spore tissue not ridged, without filamentous tissue either interior or exterior; epidermal cells of capsule thick walled, 1–3 times as long as wide about middle of capsule; stomata wanting; spores 20–22 μ, smooth. Type locality, South Carolina.

ILLUSTRATIONS:—Schwaegr. Suppl. 2^2: *pl. 156;* Sull. Icones Musc. *pl. 48;* Mosses W. H-lens *f. 11; Pl. 58C.*

EXSICCATI:—Aust. Musci Appal. 234; Grout, N. Am. Musci Perf. 262; Holz. Musci Acro. Bor. Am. 149 (mixed with *Atrichum angustatum*); Rapp, Florida Mosses 55. Cf MFI 251

On clayey banks. New Jersey to Pennsylvania and southward to Texas, Louisiana, Mississippi, Alabama and Florida. North to Conn. & Long Island.

Sullivant, Icones Musc. *pl. 48*, shows the marginal cells of the lamellae with the outer wall thicker. Brotherus, in Engler & Prantl's Nat. Pfl.-Fam. (Ed. 2) **11**: 504, 1925, places the species in a section with unthickened marginal cells. Our observations would corroborate Brotherus.

3. POGONATUM CONTORTUM (Schwaegr.) Sull. Icones Musc. Suppl. 58. *pl. 42.* 1874.

Polytrichum contortum Schwaegr. Suppl. **1** (2): 325. *pl. 96.* 1816.
Pogonatum laterale Brid. Bryol. Univ. **2**: 112. 1827.
Pogonatum atrovirens Mitt. Jour. Linn. Soc. London **8**: 49. 1865.
Pogonatum dentatum of Lesq. Mem. Cal. Acad. Sci. **1**: 27. 1868. Not *Polytrichum dentatum* Schwaegr. Suppl. **1** (2): 321. 1816.
Pogonatum erythrodontium Kindb., Macoun, Cat. Can. Pls. **6**: 150. 1892.
Catharinella contorta Kindb. Rev. Bryol. **21**: 35. 1894.
Catharinella atrovirens Kindb. Rev. Bryol. **21**: 35. 1894.
Catharinella erythrodontia Kindb. Rev. Bryol. **21**: 36. 1894.

Plants gregarious, forming loose sods, glaucous-green to brown; stems 4–6–12 cm. long, simple or branching near tip, rhizoidous at base only; leaves not crowded, spreading when moist, rather erect *when dry* but *very markedly contorted*, gradually grading into the scales on lower part of stem, linear-lanceolate, wider near base but hardly sheathing, the larger 5–7 mm. long, the limb 0.8–1.2 mm. wide; apex acute;

margin sharply and coarsely serrate to base, plane, 2 cells thick for a width of 1–3 cells; costa excurrent, slightly toothed on back above; *lamellae 20–40*, entire, 3–5 cells high; in cross section the *marginal cells like the others* or slightly larger, oval, *not thicker walled*, smooth; cells of median region of leaf sheath squarish to rectangular, 15–22 μ wide, 17–35 μ long; cells at ¾ up roundish-angular, isodiametric or nearly so, 15–20 μ in longest diameter, rather thin walled. Dioicous; male plants smaller, innovating from the middle of the tip; perichaetial leaves similar to the foliage leaves; calyptra completely covering the capsule, its hairs light-yellow and smooth; seta 3–4 cm. long, thin, somewhat twisted to the right, reddish when young, passing through brown to black with age; capsule erect to inclined, terete, grayish-green to blackish, distinctly mamillose by the swollen cells of the epidermis; urn ovate to cylindric, 3–4 mm. long, markedly contracted under the mouth, 500–600 μ thick about the middle; not constricted near base to cut off a hypophysis; lid dome-shaped, rostrate, ½–⅔ as long as the urn, beak straight or nearly so; epidermal cells of capsule rectangular, 1.5–2 times as long as wide, with all the walls very thick; stomata wanting; spore tissue decidedly ridged on the outside, without loosely filamentous tissue either interior or exterior to it; basal membrane rather high, ⅓–½ as high as the teeth are long, about 70 μ high; teeth 32, rather unequal, with some tendency toward double teeth, 250–300 μ long, about 85 μ wide, rounded at tip; spores 11–13 μ, smooth, yellowish. Type locality, West coast of North America (Menzies).

Illustrations:—Schwaegr. Suppl. **1**[2]: *pl. 96* in part; Proc. Wash. Acad. Sci. **12**: 296. *f. 12;* Sull. Icones Musc. Suppl. *pl. 42;* Engler & Prantl Nat. Pfl.-Fam. (Ed. 2) **11**: 507. *f. 784; Pl. 59A.*

Exsiccati:—Frye, Bryo. Olympic Mts. 525; Henderson, Pls. N. W. U. S. 16998; Holz. Musci Acro. Bor. Am. 175; Howell, N. Am. Mosses 1831; Macoun, Can. Musci 580; U. S. Soils Kelp Exped. Alaska 242, 393, 699, 830, 866, 939, 963, 987, 1104, 1105, 1213. Macoun 220 (as P. a...)

On clayey soil in humid situations. Alaska to California; Asia.

4. Pogonatum urnigerum (Hedw.) Beauv. Prodr. 84. 1805.

Polytrichum urnigerum Hedw. Sp. Musc. Frond. 100. *pl. 22. f. 5–7.* 1801.
Polytrichum fasciculatum Michx. Fl. Bor. Am. **2**: 294. 1803.
Pogonatum fasciculatum Beauv. Prodr. 84. 1805.
Pogonatum pulverulentum Beauv. Prodr. 84. 1805.
Polytrichum pulverulentum Beauv. Prodr. 84. 1805.
Pogonatum urnigerum var. *fasciculatum* Brid. Bryol. Univ. **2**: 126. 1827.
Pogonatum urnigerum var. *pulverulentum* Brid. Bryol. Univ. **2**: 126. 1827.

Plant gregarious, forming rather loose sods, glaucous-green to brownish; stem 2–4–10 cm. long, unbranched or commonly branched well up, several-angled, rhizoidous at base only; leaves abruptly grading into scales below; the longer leaves, spreading when moist, erect or incurved when dry, lanceolate from a sheathing base, up to 7 mm. long, the limb 450–800 μ wide; apex acute or acuminate; *margin serrate nearly or quite to the sheath*, plane; costa excurrent, sharply toothed on back near tip; *lamellae 40–50*, entire or nearly so except for papillae, 4–6 cells high; *in cross section their marginal cells* distinctly large, *round or oval and higher than wide, thick walled, distinctly papillose;* cells of sheath rectangular, hyaline; in the median region 10–15 μ wide, 25–37 μ long; cells at ¾ up squarish or hexagonal to rectangular, from shorter to longer than wide, somewhat thick walled, 17–25 μ in longest diameter. Dioicous; male plants among the female about the same size; male bracts ovate, composed of sheath with a short point of limb; perichaetial leaves with longer sheath and shorter and narrower blade; calyptra extending below the capsule, yellowish brown, the hair smooth; seta 1–3–5 cm. long, twisted to the right above, reddish at base; capsule erect to slightly inclined, terete, yellowish-brown to reddish-brown; urn ovate to cylindric, about 500 μ thick and 3 mm. long, wide mouthed, distinctly papillose or mamillose, without a hypophysis; lid 300–1000 μ long, roundish-conic, the beak straight or slightly curved; epidermal cells of the urn roundish to oval, rather thick walled, without a thin spot; stomata wanting; spore tissue with 4 longitudinal ridges on inner side, with loosely filamentous tissue both interior and exterior to it; basal membrane 100–120 μ high; teeth 32, about 180 μ long, reddish; spores 12–14 μ, smooth. Type locality, European.

Illustrations:—Hedw. Sp. Musc. Frond. *pl. 22. f. 5–7;* Broth. Laubm. Fennoskandias *f. 117E–H;* Braithw. Brit. Moss Fl. **1**: *pl. 6;* B. S. G. Bryol. Eur. *pl. 417;* Proc. Wash. Acad. Sci. **12**: 300. *f. 14;* Dixon & Jam. Stud. Handb. Brit. Mosses (Ed. 3) *pl. 5 F; Pl. 59B.*

Exsiccati:—Aust. Musci Appal. Suppl. 522; Foster 524, 1856; Grout, N. Am. Musci Perf. 31a, 31b, Hand-lens Mosses 13; Holz. Musci Acro. Bor. Am. 100; Macoun, Can. Musci 581; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 213; U. S. Soils Kelp Exped. Alaska 1036, 1237, 1241. Sull Musci Allegh. 114; Sull. & Lesq.

On soil, and on rocks with a covering of soil. Greenland to Alaska, southward to Oregon, Colorado, New York and New Hampshire; Europe; Asia; Africa; West Indies.

5. POGONATUM CAPILLARE (Rich.) Brid. Bryol. Univ. **2**: 127. 1827.

Polytrichum capillare Rich., Michx. Fl. Bor. Am. **2**: 294. 1803.
Pogonatum yuccaefolium Beauv. Prodr. 85. 1805.
Polytrichum dentatum Brid. Sp. Musc. **1**: 66. 1806.
Polytrichum capillare var. *minus* Wahlenb. Fl. Lapp. 348 in part. 1812.
Polytrichum urnigerum var. *capillare* Wahlenb. Fl. Suec. (Ed. 1) **2**: 739. 1826.
Pogonatum dentatum Brid. Bryol. Univ. **2**: 122. 1827.
Pogonatum intertextum LaPyl., Brid. Bryol. Univ. **2**: 742. 1827.
Pogonatum longidens Angstr. Thed. Nya. Bot. Not. 1852.
Polytrichum capillare var. *oxycalyx* Lindb. Bot. Not. 137. 1867.
Polytrichum capillare var. *dentatum* Lindb. Acta Soc. Sci. Fenn. **10**: 266. 1872.
Polytrichum Wahlenbergii Kindb. Rev. Bryol. **21**: 37. 1894.
Pogonatum dentatum var. *minus* Hag. Danske Kgl. N. Videns. Saellsk. Skrift. **1913** (1): 32. 1914.

Plant gregarious, forming loose sods, glaucous-green to reddish-brown; stem 2–4 cm. long, commonly unbranched but sometimes branched, 3-angled below, 5-angled in leafy part, rhizoidous only at base; leaves spreading when moist, appressed when dry, not or little twisted when dry, linear-lanceolate from a sheath-like base, up to 8 mm. long and about 500 μ wide; apex acute or acuminate; margin sharply serrate nearly to sheath; costa excurrent as a brownish tooth, smooth on back or with 1–4 low teeth near tip; *lamellae 25–55, entire*, straight, 6–8 cells high; *in cross section their marginal and often also the sub-marginal cells wider than the others, squarish to transversely rectangular; their outer wall flattish, thick, papillose, colorless to brownish;* cells of the median region of the sheath 9–14 μ wide, 17–26 μ long; cells of the unistratose leaf margin at ¾ up wider than long to squarish or somewhat rounded, 10–17 μ in longer diameter, with rather thick walls. Dioicous; male plants among the female ones, somewhat smaller; most of the male bracts toothed; perichaetial leaves with long sheath, entire to serrate, the limb almost limited to the costa; calyptra hardly covering the base of the capsule, the hairs smooth; seta 1.5–3 cm. long, twisted to the right above, with cylindrical hollow, yellowish-red; capsule slightly inclined, terete, yellowish-brown; urn oval to cylindric, about 1.5 mm. thick and 3 mm. long, wide-mouthed when empty, the mouth red; neck slightly concave to not constricted at all; lid dome-shaped, about ⅖ as long as the urn, yellow, the beak straight or nearly so, averaging about ⅔ as long as the lid is wide; epidermal cells of capsule roundish to oval, thick walled, slightly mammillate, without a central thin spot on each cell; stomata wanting; spore tissue not or indistinctly ridged on outer side, without loosely filamentous tissue either interior or exterior to it; basal membrane hardly projecting; teeth 32, about equal, 275–350 μ long, 60–80 μ wide, finely punctate; spores 13–21 μ, very nearly smooth, light yellow. Type locality, North Carolina.

ILLUSTRATIONS:—Trans. Linn. Soc. **4**: *pl. 7. f. 4;* Schwaegr. Suppl. **2**[2]: *pl. 155;* Sull. Icones Musc. *pl. 49*, also Suppl. *pl. 41;* Proc. Wash. Acad. Sci. **12**: 298. *f. 13;* Broth. Laubm. Fennoskandias *f. 117, J–L;* Engler & Prantl, Nat. Pfl.-Fam. (Ed. 2) **11**: *f. 788; Pl. 59C.*

EXSICCATI:—Aust. Musci Appal. 523; Drumm., Musci Bor. Am. (Ed. 1) 284 as *Polytrichum urnigerum;* Frye, Bryo. Olympic Mts. 13, 611; Grout, Hand-lens Mosses 11; Howell, N. Am. Mosses 1832; Holz. Musci Acro. Bor. Am. 299; Macoun, Can. Musci 219 as *Pogonatum urnigerum;* Sull. & Lesq. Musci Bor. Am. (Ed. 1) 212; Taylor, Pls. B. C. 149; U. S. Kelp Exped. Alaska 15, 511, 966, 1214, 1240.

On bare or sandy soil, often on the banks of streams at high altitudes and latitudes. Greenland to Newfoundland and New York, southward to North Carolina; Rocky Mountains; Alaska to Oregon; Europe; Asia.

6. POGONATUM ALPINUM (Hedw.) Roehl., Ann. Wett. Gesell. **3**: 226. 1812.

Polytrichum alpinum Hedw. Sp. Musc. Frond. 92. *pl. 19. f. 2* and *b.* 1801.
Polytrichum ferrugineum Brid. Sp. Musc. **1**: 61. 1806.
Polytrichum ambiguum Brid. Sp. Musc. **1**: 62. 1806.
Polytrichum furcatum Hornsch., Nees Hor. Phys. Berol. 76. 1820.
Pogonatum furcatum Brid. Bryol. Univ. **2**: 133. 1827.
Polytrichum alpinum var. *furcatum* C. Muell. Syn. Musc. Frond. **1**: 211. 1849.

Plant gregarious, forming loose sods, dull-green to reddish-brown; stem 2–8–20 cm. long, simple or usually branched, irregularly angular in the leafy part; leaves erect to spreading when dry, spreading when moist, linear-lanceolate from a long sheathing base, 6–8–10 mm. long, the lamina about 500 μ wide; apex acuminate, red, serrate; margin sharply serrate to the base or nearly so, erect; costa excurrent, toothed on back near apex; *lamellae 33–48, entire* except for papillosity, 5–8 cells high; *in cross section the marginal cells*

ovate-conic to pyriform, larger than the others, *thick walled* except on the inner side, *papillose;* cells of the central region of the sheath long-rectangular, about 9 x 45–85 μ, those toward the margin narrower; cells of the limb at about ¾ up the leaf squarish to rectangular, sometimes a little wider than long, 9–16 μ in longest diameter; cuticle striate. Dioicous; male plants shorter and more slender; male bracts obovate, pointed; perichaetial leaves much like the others; calyptra slightly shorter than the capsule, reddish brown; seta 3–5 cm. long, twisted to the right, with central hollow, reddish-yellow; *capsule* erect or usually inclined, sometimes slightly curved, *terete*, smooth or nearly so, yellowish-green to light-brown; urn narrowly ovate; to cylindric, 2–2.5 mm. thick, 2.25–4 mm. long; neck slightly contracted; lid about half as long as the urn, dome-shaped, with slightly curved beak; annulus of one row of rather small cells; epidermal cells of the capsule mostly angular, rather thick walled, isodiametric or nearly so, without a thin central region, faintly and irregularly striate; stomata restricted to the hypophysis, many, large; spore tissue with 4 longitudinal ridges on inner side, terete on outer side, with loosely filamentous tissue interior and exterior to it; peristome 210–230 μ high; basal membrane 30–50 μ high; *teeth 40–60*, sometimes irregular, *commonly unequal*, about 180 μ long, rounded at tip; spores 18–21 μ, finely punctate, ochroleucous. Type locality, European.

Illustrations:—Hedw. Sp. Musc. Frond. *pl. 19. f. 2* and *b;* B. S. G. Bryol. Eur. *pl. 418;* Proc. Wash. Acad. Sci. **12:** 302. *f. 15*, also *f. 16* in part; Braithw. Brit. Moss Fl. **1:** *pl. 6D; Pl. 60.*

Exsiccati:—Aust. Musci Appal. 521; Grout, Hand-lens Mosses 10; Holz. Musci Acro. Bor. Am. 73, 200, 595; Macoun, Can. Musci 582; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 214; Drumm. Musc. Am. 282.

On soil. Greenland to Alaska, southward to Newfoundland, New Hampshire, Vermont, New York, Ontario, Minnesota, Colorado. Idaho and Washington; Europe; Asia; Antarctica; Oceanica.

There are no sharp lines anywhere within the species *P. alpinum.* The most vigorous variation is the var. *Macounii*, with cylindrical capsule reaching at best 6 mm. long. The var. *arcticum* has rather shorter and narrower capsule, reaching at most 5 mm. long, and perhaps only half or ⅔ as wide. But this variety grades into var. *Macounii* and into typical *P. alpinum.* Typical *P. alpinum* has a capsule shorter and often but not always wider at base than farther up. Often it is merely shorter than in var. *Macounii.* Var. *septentrionale* is a rather dwarfed *P. alpinum* with the leaf serrations quite weakly developed. Var. *brevifolium* is merely a more stunted plant sometimes branched and sometimes not, and the more stunted the less likely to be branched. When unbranched it is often referred to as var. *simplex.* There does not seem to be sufficient reason for a var. *simplex*, so this is herein combined with var. *brevifolium* which constitutes those having a leaf limb not over 3 times as long as the sheath, and a capsule commonly 2–3 mm. long. The shorter leaves go with the shorter capsules. There appears to be no break in the gradation from the largest to the smallest where a line of specific value may be drawn.

Hasselbo in Medd. om Groenland **43:** 171, 1910, reports *Polytrichum fragile* Bryhn from the east coast of Greenland. We have neither material nor description of this. However, Brotherus in Engler & Prantl (Ed. 2) **11:** 512, 1925, refers it to the *alpinum* group.

6a. Var. Macounii (Kindb.) Card. & Thér., Proc. Wash. Acad. Sci. **4:** 328. 1902.

Pogonatum Macounii Kindb. Bull., Torr. Club **16:** 96. 1889.
Polytrichum Macounii Kindb. Bidrag. 453, according to Paris Index Bryol. (Ed. 2) **4:** 49. 1905.

Stems 5–7–14 cm. long, simple or slightly branched above; *leaves* narrowly lanceolate from a sheathing base, *12–14 mm. long*, the limb 5–7 mm. wide. *Urn* of the capsule *5–6 mm. long, 1–1.5 mm. thick.* Type locality, along the borders of ravines at an altitude of 4500 feet on Mt. Arrowsmith on Vancouver Island, British Columbia (John Macoun) July 13, 1887.

Illustrations:—Proc. Wash. Acad. Sci. **12:** 305. *f. 16; Pl. 60.*

Exsiccati:—Allen, Mosses Cascade Mts. 77; Holz. Musci Acro. Bor. Am. 200 b, 417; U. S. Soils Kelp Exped. Alaska 139, 394, 449, 486, 518, 775.

On soil and in rock crevices in damp situations. Alaska, British Columbia, Washington; Asia.

The var. *Macounii* is nearest the var. *arcticum*, both having long capsules. The former has thicker capsules and is a larger looser plant. There is no sharp boundary between these two varieties.

6b. Var. arcticum (Wahlenb.) Brid. Bryol. Univ. **2:** 131. 1827.

Polytrichum alpinum var. *arcticum* Wahlenb. Fl. Lapp. 346. 1812.
Pogonatum arcticum Roehl., Ann. Wett. Gesell. **3:** 226. 1812.
*Pogonatum Pylaesii** Brid. Bryol. Univ. **2:** 744. 1827.
Pogonatum alpinum var. *angustifolium* Lindb. Bot. Not. 130. 1867.

* This is the spelling by Bridel. Many European authors spell it Pylaisii.

Pogonatum alpinum var. *silvaticum* Lindb. Bot. Not. 130. 1867.
Polytrichum alpinum var. *silvaticum* Lindb. Musc. Scand. 12. 1879.

Larger leaves 7–8 mm. long; seta 2–4 cm. long; *capsule cylindric*, narrow, 3–5 times as long as wide, 4–5 mm. long. Type locality probably given in Trans. Linn. Soc. **4:** 12, 1798, which is not available to us.

ILLUSTRATIONS:—Trans. Linn. Soc. **4:** *pl. 7. f. 6;* Sw. Musc. Suec. *pl. 8. f. 17;* Proc. Wash. Acad. Sci. **12:** 306. *f. 17; Pl. 60.*
EXSICCATI:—U. S. Soils Kelp Exped. Alaska 1239.
On soil. Greenland, Nova Scotia, Minnesota, Alaska, Washington; Europe.

6c. Var. SEPTENTRIONALE (Roehl.) Brid. Bryol. Univ. **2:** 131. 1827.

Pogonatum septentrionale Roehl. Ann. Wett. Gesell. **3:** 226. 1812.
Polytrichum septentrionale Brid. Mant. Musc. **4:** 198. 1819.
Polytrichum alpinum var. *septentrionale* Lindb. Not. Saellsk. Fauna Fl. Fenn. **9:** 131. 1867.
Pogonatum alpinum var. *microdontium* Kindb., Macoun Cat. Can. Pls. **6:** 152. 1892.

Leaves almost to quite entire. Type locality, Scandinavian Peninsula.

ILLUSTRATIONS:—Proc. Wash. Acad. Sci. **12:** 306. *f. 17; Pl. 60.*
EXSICCATI:—Macoun, Can. Musci 582a, 427, 600.
On soil. Greenland, Alaska to British Columbia and Colorado; Europe; Asia.
From the description of *Polytrichum polare* C. Muell., Bot. Leit. **17:** 205, 1859, later published as *Pogonatum polare* Jaeg. Gen. et Sp. Musc. Syst. Adumbratio Fl. Musc. **1:** 742, 1873–1874, it seems that probably it falls under *Pogonatum alpinum* var. *septentrionale.* However, we have not been able to see the material, and the marginal cells of the lamellae, which are crucial in determining the species, are unfortunately not described. *Pogonatum polare* is reported from Greenland.
Likewise *Pogonatum Vanhoeffeni* Kindb. Biblioth. Bot. **42:** 66, 1897, seems to fall under *Pogonatum alpinum* var. *septentrionale*, although the description is quite inadequate even to show conclusively that it is a *Pogonatum* rather than a *Polytrichum.* I have been unable to borrow a specimen for examination. It was described from material gathered in Greenland by E. Vanhoeffen.

6d. Var. BREVIFOLIUM Brid. Bryol. Univ. **2:** 131. 1827.

Polytrichum brevifolium R. Br. Parry's Voyage Suppl. 294. 1824.
Pogonatum campanulatum Brid. Bryol. Univ. **2:** 133. 1827.
Pogonatum alpinum var. *campanulatum* B. S. G. Bryol. Eur. **21–22:** 9. 1844.
Polytrichum campanulatum Hornsch., Nees Hor. Phys. Berol. 67. *pl. 13.* 1820.
Polytrichum alpinum var. *campanulatum* Angstr. Fr. Summ. Veg. 90. 1846.
Polytrichum alpinum var. *brevifolium* C. Muell. Syn. Musc. **1:** 211. 1849.
Pogonatum alpinum var. *simplex* Schimp. Coroll. Bryol. Eur. 91. 1856.

Plants small; stems 1–4 cm.; leaves sharply serrate as in the type, short, 5–8 mm. long; limb 1–3.5 times as long as the sheath. Seta short, 1–3 cm. long; capsule smaller, 1.8–3 mm. long. Type locality, Unalaska, Alaska (Chamisso).

ILLUSTRATIONS:—Nees Hor. Phys. Berol. *pl. 13;* Proc. Wash. Acad. Sci. **12:** 306. *f. 17; Pl. 60.*
On wet rocks and shady banks in mountains or far north. Greenland, Melville Island, Alaska southward to Massachusetts, Colorado and California; Iceland; Europe; Asia.

5. POLYTRICHUM Hedw. Sp. Musc. Frond. 88. 1801.

Plants in loose to dense sods, green, brown with age; stems stiff, from subterranean rhizome, with central strand of two kinds of cells, scaly below, mostly densely leafy above; leaves grading into the bracts below them; larger leaves usually erect when dry, lanceolate to linear-lanceolate from a sheathing base, the sheath one cell thick, often with little chlorophyll; margin of the limb entire to coarsely toothed, the unistratose portion 2–15 cells wide; *costa of rather indefinite width*, often toothed on back near tip, *with many* ventral *lamellae*, often excurrent as an awn. Dioicous; male plants among the female; male inflorescence cup-shaped to saucer-shaped, rejuvenating from the center; *calyptra densely hairy* so that its body is hidden, cucullate, the hairs not papillose; seta elongate, stiff; *capsules* solitary, *4–6-angled, with stomata* at base, with *hypophysis* from *fairly distinct to constricted from the base* of the urn; *teeth of the peristome 64*, composed of whole thick walled cells; lid flattish to conical, usually with a beak.

KEY.

A. Leaf margin more or less toothed.
  B. Marginal cells of lamellae like the others in size and thickness of wall; lamellae entire.
    C. Cells of middle of leaf sheath at ⅔ distance from margin to costa 5.5–9 times as long as wide; at ¾ up the leaf the unistratose margin 2–3 cells wide; epidermal cells of the capsule with or without surface thin spot... *1. formosum.*
    CC. Cells of middle of leaf sheath at ⅔ distance from margin to costa 1.5–4 times as long as wide; at ¾ up the leaf the unistratose margin 4–9 cells wide; epidermal cells of the capsule without surface thin spot..... *2. gracile.*
  BB. Marginal cells of lamellae unlike the others in size or thickening of wall.
    D. Marginal cells of lamellae flat-topped, not notched or only near leaf margins and base slightly so.
      E. Marginal cells of lamellae thicker walled than the others; epidermal cells of the capsule without surface thin spot..... *3. ohioense.*
      EE. Marginal cells of lamellae not thicker walled than the others; epidermal cells of the capsule with surface thin spot..... *4. Swartzii.*
    DD. Marginal cells of lamellae notched in cross section (*P. commune* and varieties).
      F. Leaves toothed to the sheath or nearly so.
        G. Perichaetial leaves about like the others..... *5. commune* (typical).
        GG. Perichaetial leaves distinctly longer and erect in a tuft about the seta..... *5a.* var. *perigoniale.*
      FF. Leaves toothed to about the middle of the limb..... *5b.* var. *Jensenii.*
    DDD. Marginal cells of lamellae pear-shaped.....*7 b. var. Waghornei.*
AA. Leaf margin entire.
  H. Marginal cells of lamellae notched in cross section..... *5c.* var. *yukonense.*
  HH. Marginal cells of lamellae not notched in cross section, more or less pear-shaped.
    I. Leaves blunt, cucullate; capsule usually 6-angled..... *6. norvegicum.*
    II. Leaves with costa excurrent as an awn; capsule 4-angled.
      J. Awn of the leaf reddish.
        K. Stem with rhizoids only at base; capsule 1.5–2 times as long as thick; leaves entire..... *7. juniperinum.*
        KK. Stem with dense mat of rhizoids even up among well developed leaves; capsule hardly longer than thick; leaves entire..... *7a.* var. *alpestre.*
        KKK. Stems with rhizoids only at base; capsule unknown; leaves somewhat serrulate near tip..... *7b.* var. *Waghornei.*
      JJ. Awn of the leaf hyaline or merely reddish at base.
        L. Stems simple, short, densely leafy..... *8. piliferum.*
        LL. Stems mostly branched, extended, laxly leafy..... *8a.* var. *hyperboreum.*

1. POLYTRICHUM FORMOSUM Hedw. Sp. Musc. Frond. 92. *pl. 19. f. 1a.* 1801.

Polytrichum pallidisetum Funck, Hoppe Bot. Tasch. 44. 1802.
Polytrichum attenuatum Menz., Smith Eng. Bot. *pl. 1198.* 1803.
Polytrichum commune var. *attenuatum* H. & T. Muscol. Brit. 26. 1818.
Polytrichum formosum var. *quadrangulare* Hartm. Skand. Fl. (Ed. 1) 404. 1820.
Polytrichum formosum var. *pallidisetum* Steud. Nom. Crypt. 352. 1824.
Polytrichum coronatum Brid. Bryol. Univ. **2:** 748. 1827.
Polytrichum superbum Schultz, Syl. Fl. 152. 1828.
Polytrichum formosum var. *superbum* Fiedl. Laubm. Meckl. 97. 1844.
Atrichum anomalum Milde, Bot. Zeit. **27:** 824. 1869.
Polytrichum conorhynchum Kindb., Macoun Cat. Can. Pls. **6:** 154. 1892.

Plants forming thin sods, dark-green to brownish-green; stems 6–12–22 cm. long, unbranched or forked, several-angled in cross section; central strand in leafy region well defined, its cells thick walled, brownish; outward from the strand several layers of thin walled cells, the outermost portion of 2–3 layers of thick walled cells larger than those of the strand; rhizoids only at the base of the upright stems; leaves spreading when moist, erect or nearly so when dry, linear-lanceolate from a sheathing base, 5–7–12 mm. long; the limb 770–1000 μ wide; *apex acuminate into a serrate and usually red point; margin serrate nearly to sheath,* plane to erect; teeth quite spinose, *the unistratose portion near middle of limb usually 2–3 cells wide;* costa excurrent, toothed on back above; *lamellae* 30–70, *entire,* 3–5 cells high; *in cross section the marginal ones like the others or slightly larger,* isodiametric or slightly wider than long, *smooth, not or hardly thicker walled; cells of leaf sheath 5–10 times as long as wide,* hyaline, median ones 10–15 μ wide, 55–120 μ long, cells of the unistratose border at ¾ up squarish to roundish or oval, 10–22 μ in longest diameter. Dioicous; male plants shorter, more slender; male bracts cuspidate; perichaetial leaves longer than the foliage leaves, long acuminate, the sheath about half the length, not membranous; calyptra covering the whole capsule, light reddish-brown, quite hairy; seta 4–8 cm. long, stout, flattened toward top, not twisted, yellowish-red, often light yellow above; capsule erect to horizontal, acutely 5–6-angled, rarely 4-angled, light-yellow to brownish-yellow; urn about 2.5 mm. thick and 5 mm. long; hypophysis constricted from the urn; lid broadly conic, about ⅓ the length of the urn, beak straight, rim red; epidermal cells of the capsule somewhat turgid, thick-walled, with or without median thin spot on outer side, irregularly roundish or 4–6-angled, in the middle of the urn about 35 μ; stomata numerous, in the neck region, oval, 2-celled, the opening a crack; spore tissue with filamentous tissue at least external to it; teeth 64, equal, mostly about 240 μ long and 75 μ wide, papillose; basal membrane projecting about 70 μ, orange; spores 10–14 μ, finely punctate, ochraceous. Type locality, "Bei den Vogelsteinen in der Oberlausitz," Germany (C. Ludwig).

Illustrations:—Hedw. Sp. Musc. Frond. *pl. 19. f. 1 and a;* Proc. Wash. Acad. Sci. **12:** 311. *f. 19;* Bryol. Eur. *pl. 420;* Braithw. Brit. Moss Fl. **1:** *pl. 7* in part; Dixon & Jam. Stud. Handb. Brit. Mosses (Ed. 3) *pl. 6F;* Engler & Prantl Nat. Pfl.-Fam. (Ed. 2) **10:** 34–35. *f. 32–33; Pl. 61A.*

Exsiccati:—Aust. Musci Appal. 236; Grout, N. Am. Musci Perf. 220; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 215; U. S. Soils Kelp Exped. Alaska 52, 212, 264, 564, 620, 831, 1095, 1106, 1117, 1209, 1211, 1223, Yakutat Bay, Alaska (F. Funston 152) as *Polytrichum urnigerum;* Drummond, 279 as *P. pallidisetum.*

On soil and rocks. Greenland southwestward to Miquelon Isl., New Hampshire; Vermont, Connecticut, North Carolina, New York and Ontario; Alaska to Oregon; Europe; Asia; Africa.

P. formosum sometimes has a thin spot in the surface cell of the capsule and sometimes not. Possibly they do not show in rather immature capsules; naturally they are not yet present in very young ones.

2. Polytrichum gracile Sm. Fl. Brit. **3:** 1374. 1804.

*Polytrichum marginatum** Wahlenb., Web. & Mohr. Ind. Mus. Pl. Crypt. 1803.
Polytrichum attenuatum var. *aurantiacum* Turn. Musc. Hibern. 84. 1804.
Polytrichum longisetum var. *aurantiacum* Turn. Musc. Hibern. 84. 1804.
Polytrichum longisetum Brid. Sp. Musc. **1:** 59. 1806.
Polytrichum aurantiacum Wahlenb. Fl. Lapp. 345. 1812.
Polytrichum formosum var. *aurantiacum* Hartm. Skand. Fl. (Ed. 1) 404. 1820.
Polytrichum commune var. *aurantiacum* Wahlenb. Fl. Suec. (Ed. 1) **2:** 734. 1826.
Polytrichum formosum var. *gracile* Vent. & Bott. Enum. Crit. 30. 1884.
Catharinea Dixoni Braithw., Dixon in Jour. Bot. Brit. **23:** 169. 1885.
Catharinella Dixoni Kindb. Eur. & N. Am. Bryin. 157. 1897.

Plants densely tufted, dark green; stems 3–5–10 cm. long, nearly always simple, angular; rhizoidous below the leafy portion, the rhizoids numerous, whitish, matting the stems together; leaves erect-patent when moist, applied to the stem and somewhat flexuose or curled when dry, lanceolate from a sheathing base, the longer 8–10 mm. long, the limb 600–900 μ wide; apex gradually narrowed to a sharp, acute, serrate, red arista; margin serrate to near the sheath, erect, the *unistratose portion usually 4–9 cells wide* near the middle of the limb; leaf teeth spinose; costa excurrent, smooth or with 1–2 small teeth on back; lamellae 30–45,

* Dr. J. H. Barnhart, of the New York Botanical Garden, has kindly checked the synonymy but it seems doubtful whether any description accompanied the publication of the name *Polytrichum marginatum* in Weber & Mohr, or Mohr, "Index musei plantarum cryptogamicarum." Neither he nor I have seen the work. It is considered best to leave the plant *Polytrichum gracile* until it is certain that *P. marginatum* is not a *nomen nudum.*

entire, 4–6 cells high; in cross section the *marginal cells like the others, smooth, rounded, not thicker walled;* cells of the leaf sheath rectangular; median ones 15–19 μ wide, 30–60 μ long, thus *about 2–4 times as long as wide;* cells of the unistratose border about ¾ up 15–18 μ, round-quadrate to transversely elliptic. Dioicous, male plants with shorter leaves; male bracts obovate, acuminate; perichaetial leaves about 12 mm. long, the sheath constituting about half the length, membranous at margin, apex longer pointed than the foliage leaves; calyptra covering half to nearly all the capsule, rusty yellow; seta 4–10 cm. long, thin flexuose; capsule erect to horizontal, obtusely and often obscurely 5–6 angled, broadly ovate, narrower at the red mouth; urn about 2.5 mm. thick and 4 mm. long, yellowish-green, brown with age; hypophysis hardly constricted from urn, but constriction more prominent with age; lid about half as long as the urn, rather long-beaked from a conic base, the beak curved; *epidermal cells of the capsule* 4–6-angled, 1–2 times as long as wide, only slightly thick walled, *without central thin spot;* stomata only at the neck, 2-celled, spore tissue with 4 or 8 longitudinal ridges, with loosely filamentous tissue both interior and exterior to it; basal membrane hardly projecting from the mouth; teeth 64 or fewer through confluence, unequal, finely papillose, about 50 μ wide and 280–320 μ long; spores 18–20 μ, finely warty, olive green. Type locality, European.

Illustrations:—Schwaegr. Suppl. **2**[1]: *pl. 148;* B. S. G. Bryol. Eur. *pl. 421;* Proc. Wash. Acad. Sci. **12**: 310. *f. 18;* Braithw. Brit. Moss Fl. **1**: *pl. 7B;* Limpr. Laubm. **2**: 622. *f. 322;* Dixon & Jam. Stud. Handb. Brit. Mosses (Ed. 3) *pl. 6D; Pl. 61B.*

Exsiccati:—Sull. & Lesq. Musci Bor. Am. (Ed. 1) 216; U. S. Soils Kelp Exped. Alaska ~~1106~~; Drummond 276, as *P. formosum,* and 280 as *P. pallidisetum* var. Sull. & Lesq. 324

On damp soil at both low and high altitudes. Greenland to Alaska, southward to Connecticut, Ohio, Florida, Minnesota, Colorado, and Oregon; Europe; Asia; New Zealand.

The separation between *P. formosum* and *P. gracile* is not distinct. The ovate form of the capsule, the shorter leaves and more blunt angles of the capsule of *P. gracile* cannot be relied upon when material from widely different regions is considered. The age of the capsule has a great deal to do with the sharpness of the angles. All the Polytrichaceae have terete capsules when young. Variations in the form of capsules and size of leaves are not concurrent. Perhaps the best character upon which to rely is the shorter cells of the sheath in *P. gracile.* With this, at least nearly always, goes the wider unistratose margin of the limb. It is desirable that someone examine a great deal of material from various regions of the earth to find just what is reliable. We are in doubt whether this is best recognized as a species or as a variety of *P. formosum.*

All material of *P. gracile* seen from Colorado proved to be *Polytrichadelphus Lyallii* except one collection by Grout near Tolland in 1914. It may therefore be wise to mention that the latter always shows the outer walls of the marginal cells of the lamellae much thickened, while the former does not. This is the easiest way to be sure between the two when the material is only vegetative. A side view of a lamella will distinguish the two at a glance.

3. Polytrichum ohioense Ren. & Card., Rev. Bryol. **12**: 11. 1885.

Polytrichum formosum of Lesq. & James, Man. Mosses N. Am. 264. 1884. Not of Hedw. Sp. Musc. Frond. 92. *pl. 19, f. 1* and *a.* 1801.

Polytrichum decipiens Limpr. Jahrb. Schles. Gesell. Vaterl. Cult. **67**[2]: 93. 1890.

Polytrichum Smithiae Grout, Bryol. **6**: 41. *pl. 8. f. 1, 10–11.* 1903.

Plants forming loose sods, bluish-green to reddish-brown; stems 2.5–5–8 cm. long, mostly unbranched, rarely forked, 3-angled below, 5-angled in leafy part; central strand in leafy part colorless, surrounded by a layer of large thin walled cells, the outermost 1–2 cortical layers of small yellowish stereid cells; rhizoids only near base of stem, not very abundant; leaves spreading to recurved when moist, erect-spreading to appressed when dry and somewhat contorted, rather crowded, linear-lanceolate from a sheathing base, 5–8–12 mm. long, the limb about 1 mm. wide; sheath 2–3 mm. long, with hyaline margin; apex acuminate, aristate; arista red to pellucid, serrate; margin serrate nearly to sheath, plane to erect, the unistratose border of the limb very narrow; costa excurrent, with few teeth at back at tip; lamellae 32–50, entire or indistinctly crenulate, 4–6 cells high; *in cross section the marginal cells transversely oval, from not at all to rather thick walled,* about 20 μ wide, smooth; cells of leaf-sheath at margin very narrow, 45–105 μ long, 11–17 μ wide, about 4–8 times as long as wide; cells of unistratose border at ¾ up mostly squarish, 10–20 μ, the cuticle distinctly longitudinally striate. Dioicous; male plants intermingled with the female, innovating from the center of the inflorescence, male bracts obovate, with a serrate arista; perichaetial leaves little differing from the upper foliage leaves, spreading from their middle; the sheath yellowish-green, not membranous; calyptra as long or longer than the capsule, light yellowish-brown; seta 4–8 cm. long; slender, shining, undulate, twisted to the right, dark-brown below, yellowish-brown above; capsule erect to pendent, rather weakly but acutely 4–5-angled, greenish-yellow to yellowish-brown; urn oblong, sometimes unsym-

metric through swelling on one side in lower half, about 1.5–3 mm. thick and 3–6 mm. long; neck not or only indistinctly constricted; lid ½–⅔ as long as the urn, depressed-conic, beak curved, pale; epidermal cells of the capsule 4–6-angled with rounded angles, rather thick-walled, 7–10 μ wide, 10–15 μ long in median part of urn, *without central thin spot;* stomata restricted to the neck region, numerous, about 85 μ, the pore slit-like; spore tissue with 4 interior ridges but almost terete, with loosely filamentous tissue both interior and exterior to it; basal membrane about 90 μ high; teeth 64, regular, 90–200 μ long, 35–50 μ wide, papillose; spores 8–17 μ, finely punctate, ochroleucous. Type locality, Ohio (Provost).

Illustrations:—Bot. Gaz. **13:** *pl. 17. f. a* and *e;* Proc. Wash. Acad. Sci. **12:** 313. *f. 20;* Jennings Man. Mosses W. Pennsylvania *pl. 28* in part; Bryol. **6:** *pl. 8. f. 1., 10–11;* Grout, Mosses with Hand-lens & Microscope *f. 15* (*1–4, 10–12*), *16a* and *17e*, Mosses W. H-lens *pl. 11 and f. 8; Pl. 62A.*

Exsiccati:—Grout, N. Am. Musci Perf. 1, Hand-lens Mosses 16; Holz. Musci Acro. Bor. Am. 50, 124, 300; Macoun, Can. Musci 588; Sharp, Fl. Tennessee Bryo. 78,100. Sull, Musci Allegh. 110 (as P. formosum)

On soil and rocks. Labrador to Quebec, Minnesota and Alaska, southward to North Carolina, Alabama, Missouri and Oregon; Europe.

Examination of European material of *P. decipiens* leaves one with the conclusion that it is *P. ohioense.* Bauer's Musci Eur. Am. Exsic. No. 2050b for example, from Bavaria, would unhesitatingly be pronounced *P. ohioense* if gathered in Ohio. The terminal cells of the lamellae in cross sections of leaves are wide like those in typical *P. ohioense.*

I have examined material of *P. Smithiae* from Maine and Pennsylvania as well as the type material from Mt. Mansfield, Vt. It seems to me to be unquestionably *P. ohioense* growing under difficulties probably on account of the altitude. All the material I have seen was collected on mountains. *P. ohioense* is a lowland form. *P. Smithiae* agrees with it in all essential characters, but the capsules are slightly smaller and so are the leaves. With smaller leaves go smaller leaf cells as one would expect. I have no hesitancy in referring it to *P. ohioense*, considering it not worthy of a variety.

4. Polytrichum Swartzii, Hartm. Skand. Fl. (Ed. 5) 361. 1849.

Polytrichum alpestre Sw. Summ. Veg. Scand. 1814. Not of Hoppe Bot. Tasch. 198. 1801.
Polytrichum remotifolia Schwaegr. Suppl. **1²:** 320. 1816. Not of Beauv. Prodr. 86. 1805.
Polytrichum commune var. *Swartzii* Hartm. Skand. Fl. (Ed. 9) **2:** 43. 1864.
Polytrichum algidum Hag. & Jens. Medd. om Groenland **15:** 384. *f. 1–4.* 1897.
Polytrichum commune var. *nigrescens* Warnst. Verh. Bot. Ver. Brandenburg **41:** 65. 1899.
Polytrichum inconstans Hag. Nyt. Mag. Naturvid. **38:** 339. 1900.
Polytrichum Swartzii var. *nigrescens* Hag. Danske Kgl. N. Videns. Saellsk. Skrift. **1913** (1): 53. 1914.

Plants gregarious, green to black, rather narrow; stem simple or forked, up to 5 cm. long, sometimes innovating from the base, nude below, distinctly triangular when dry, about 400 μ thick, polytrichoid, suddenly leafy upward, rhizoidous from base to well up the stem; leaves somewhat rigid, the lower spreading when moist, the upper erect, shining, about 5 mm. long, narrowly lanceolate from a sheathing base, about 3.7 mm. long and 440 μ wide above the sheath; sheath entire, rectangular, dark yellow, widely hyaline, about 1.3 mm. long and 740 μ wide, 1 cell thick, the cells rather thick walled and near the margin linear; apex ending in a smooth reddish arista composed of the excurrent costa, acute; margin erect, from the sheath dentate or only so toward tip, rarely entire, erect, or incurved, the unistratose portion 2–6 cells wide; costa 350 μ wide, more or less keeled toward the apex, smooth or somewhat toothed on the back, well defined in the sheath; cells of the median region of the sheath 76–114 x 9–13 μ; cells of unistratose margin isodiametric to wider than long, or longer than wide, 9–19 μ in longest diameter, moderately thick walled; lamellae 30–40, 4–9 cells high, subcrenulate to entire; *the marginal cells mostly wider than high, thin walled to slightly thicker and brownish, smooth, mostly flat-topped or slightly notched in cross section.* Dioicous; calyptra extending well below the capsule, yellowish-brown to almost black; perichaetial leaves with long sheath, with wide hyaline margin; seta 5–8 cm. long, red; capsule cubical-ovate, sharply 4-angled, finally horizontal; urn about 3 mm. long, reddish-brown when old; teeth of the peristome 64, about alike in size; lid half as wide as the urn, arched or flat, thin, with a curved beak; epidermal layer of capsule of isodiametric cells, thick walled, *with distinct thin spot in each cell;* hypophysis distinctly constricted from the urn; stomata present. Type locality, Near Stockholm, Sweden.

Illustrations:—Medd. om Groenland **15:** 384. *f. 1–4;* Proc. Wash. Acad. Sci. **12:** 314. *f. 21;* Schwaegr. Suppl. **1** (2): *pl. 97; Pl. 62B.*

On soil in wet places. Greenland; Yukon; Iceland; Europe; Asia.

5. POLYTRICHUM COMMUNE Hedw. Sp. Musc. Frond. 88. 1801.

Polytrichum propinquum R. Br. Parry's Voyage Suppl. 294. 1824.
Polytrichum quadrangulare Gilib. Steud. Nom. Crypt. 353. 1824.
Polytrichum commune var. *minus* Brid. Bryol. Univ. **2**: 150. 1827.
Polytrichum commune var. *humile* Sw. Annot. Bot. 141. 1829.
Polytrichum commune var. *uliginosum* Hueb. Muscol. Germ. 535. 1833.
Polytrichum commune var. *fastigiatum* Wils. Bryol. Brit. 212. 1855.
Polytrichum cubicum var. *fastigiatum* Lindb. Not. Saellsk. Fauna Fl. Foerk. **9**: 49. 1867.
Polytrichum cubicum var. *pygmaeum* Lindb. Not. Saellsk. Fauna Fl. Foerk. **9**: 118. 1867.
Polytrichum cubicum Lindb. Not. Saellsk. Fauna Fl. Foerk. **9**: 119. 1867.
Polytrichum commune var. *yuccaefolium* DeNot. Epil. 330. 1869.
Polytrichum formosum var. *pallidisetum* of Lesq. & James, Man. Mosses N. Am. 264. 1884. Not of Steud. Nom. Crypt. 352. 1824.
Polytrichum commune var. *brevifolium* C. Jens. Medd. om Groenland **3**: 354. 1887.
Polytrichum commune var. *canadense* Kindb., Macoun Cat. Can. Pls. **6**: 156. 1892.
Polytrichum commune var. *pygmaeum* Paris, Index Bryol. (Ed. 1) 993. 1897.

Plants forming dense sods, these sometimes covering rather extensive areas, dark olive-green; stems 10–20–40 cm. long, unbranched or very rarely forked, 3-angled in the creeping portion, 5- or more-angled in the leafy portion; rhizoidous only on basal portion of stem; leaves spreading or recurved when moist, appressed or merely the tips spreading when dry, lanceolate from a sheathing base, 8–12 mm. long; sheath about 1.5 mm. wide and 3 mm. long; apex acuminate, brown or red, serrate; *margin serrate to the sheath*, plane, of about 1 row of cells; costa excurrent, sharply serrate on back near tip; lamellae 40–70, entire or slightly crenulate, with a central longitudinal groove, 4–9 cells high; *in cross section the terminal cells slightly wider, depressed in the middle, the outer wall not or little thicker;* cells of the median region of the leaf sheath linear, 95–160 μ long, 9–13 μ wide; cells of the unistratose border squarish or transversely rectangular or elliptic, about 9–19 μ in longest diameter. Plants unisexual; male plants shorter, with shorter leaves, repeatedly proliferous from the center; male bracts broadly obovate, shortly acuminate; perichaetial leaves up to 20 mm. long, with long sheath, membranous, with few or no lamellae, aristate; calyptra entirely covering the capsule, yellow or brownish with a silky luster; seta 6–9–12 cm. long. thick, slightly twisted to the right, reddish-brown, shining; capsule erect to horizontal, sharply 4-angled or rarely 5–6-angled, reddish-brown; urn almost cubical to 1.5 times as long as thick, 3–6 mm. long; neck deeply constricted; apophysis very distinct; lid depressed-conic; beak 1 mm. long, straight or slightly curved; annulus wanting; epidermal cells mostly 4–6-angled, thick-walled, about 35 μ, *each with a* conical papilla bearing a *small elliptic to cleft-like central thin spot;* stomata very large, 2-celled; basal membrane of the peristome about 100 μ high; teeth 64, about equal, about 250 μ long; spores 8–10 μ, smooth, yellowish. Type locality, European.

ILLUSTRATIONS:—Jennings, Man. Mosses W. Pennsylvania *pl. 29* in part; Bryol. Eur. *pl. 425;* Dixon & Jam. Stud. Handb. Brit. Mosses (Ed. 3) *pl. 7A;* Proc. Wash. Acad. Sci. **12**: 316. *f. 22, 23* in part; Braithw. Brit. Moss Fl. **1**: *pl. 9; Pl. 63.*

EXSICCATI:—Aust. Musci Appal. 235; Drumm. Musci Bor. Am. 279 (as *P. pallidestum*), 73; Fernald & Wiegand, Fl. Newfoundland 6471, 6475, 6515, 6530, 6537; Grout, N. Am. Musci Perf. 34; Holz. Musci Acro. Bor. Am. 49, 74, 150 (as sterile *P. decipiens* with lamellae largely notched in cross section), 519, 671 (as *P. Jensenii*); Macoun, Can. Musci 595; Piper, Pls. Priest Lake, Idaho 348; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 220. ♂ MFT 251

On damp soil, common along margins of ponds or lakes. Greenland to Yukon and Alaska, southward to North Carolina, Florida, Louisiana, Michigan, Minnesota, Wyoming, Arizona, Idaho and California; S. America; Europe; Asia; Africa; Oceanica.

P. commune likes wet situations. But the wet places often dry in summer, in some seasons earlier than in others, thus hindering development and resulting in small plants with small capsules. I have found *P. commune* on almost bare dry rocks; but the rock was the bottom of a shallow pool until about July 1. Around a pond in open pasture one finds the var. *minus* on the outer rim of the *P. commune* zone where the conditions are most difficult on account of dryness.

The only character which seems to be of value is the long perichaetial leaves in var. *perigoniale.* One finds plants, however, which leave one uncertain between the type and the var. *perigoniale.* Thus the var. *perigoniale* consists of those plants with more evident elongation of the perichaetial leaves. We find no characteristics separating the variety sharply, but an extensive study of intergradations and their conditions of growth should be made to determine the value of the variety.

5a. Var. PERIGONIALE (Michx.) B. S. G. Bryol. Eur. **21–22**: 13. 1844.

Polytrichum perigoniale Michx. Fl. Bor. Am. **2**: 293. 1803.
Polytrichum yuccaefolium var. *perigoniale* Mart. Fl. Crypt. Erlang. 83. 1817.
Polytrichum commune var. *campestre* Wall. Fl. Germ. **1**: 201. 1831.

Lamellae 6–9 cells high. *Inner perichaetial leaves much exceeding the foliage leaves; beak* of the lid *straight.* Type locality, European.

ILLUSTRATIONS:—Braithw. Brit. Moss Fl. **1**: *pl. 9. f. B;* Proc. Wash. Acad. Sci. **12**: 318. *f. 23* in part; *Pl. 63.*
EXSICCATI:—Fernald & Wiegand, Fl. Newfoundland 6531; Macoun, Can. Musci 595a; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 221.
On soil subject to drying out in summer. Newfoundland to Alaska, southward to North Carolina, Wyoming and Washington; Europe; Azores; Australia.

5b. Var. JENSENII Moenk., Rabenh. Krypt.-Fl. (Ed. 2) **4**: 919. 1927.

Polytrichum commune cubicum var. *integrifolium* Broth. Acta Soc. Fauna Fl. Fenn. **6⁴**: 44. 1890.
Polytrichum Jensenii Hag. Medd. om Groenland **15**: 444. 1898.
Polytrichum commune var. *integrifolium* C. Jens. Medd. om Groenland **15**: 444. 1898. As synonym.

Stems long; leaves not crowded, the sheath almost twice as long as wide; margin somewhat involute at least above, *serrate usually from about the middle of the leaf up;* leaf teeth rather weak and distant. Type locality, Lapland.

ILLUSTRATIONS:—Holz. Asa Gray Bull. **3**: 95–99. *f. 6;* Proc. Wash. Acad. Sci. **12**: 319. *f. 24; Pl. 63.*
Examined:—Bethel, Alaska (Rev. Butzin) July 4, 1925, as *P. alaskanum.* Tanana, Alaska (O. D. Clark) 1911. Source of Deadwood River, Idaho (Frye) 1934. Yellowstone National Park, Wyoming (Aven Nelson 6131).
In sphagnum bogs and on soil. Greenland; Alaska; Wyoming; Europe.
Polytrichum commune cubicum var. *integrifolium* Broth. is the earliest name. We have no means of checking whether there is an adequate description in Acta Soc. Fauna Fl. Fenn. **6⁴**: 44. 1890. If there is, the moss should go under the name *Polytrichum commune* var. *integrifolium* (Broth.) C. Jens., Medd. om Groenland **15**: 444, 1898.
The var. *Jensenii* differs from the species chiefly in that the former has weak leaf teeth which extend down about half way to the base of the limb. But this does not hold entirely, for on the same plant, in leaves of about the same size and even the same region there is variation in the distance the leaf teeth extend downward. In some leaves the teeth extend nearly to the base of the limb. The teeth are, however, relatively weak, as compared with typical *P. commune.* It does not seem to merit a species in rank. The plants are like the more elongated forms of *P. commune* with less crowded leaves.

5c. Var. YUKONENSE (Card. & Thér.) **n. comb.**

Polytrichum yukonense Card. & Thér. Proc. Wash. Acad. Sci. **4**: 329. 1902.

Leaves 4–6 mm. long, about 1 mm. wide, *margin* erect, *entire;* lamellae 8–12 cells high; arista red, entire. Type locality, Yukon River, Alaska (W. H. Dall) 1867.

ILLUSTRATIONS:—Proc. Wash. Acad. Sci. **4**: *pl. 22. f. 1a–f;* **12**: 320. *f. 25; Pl. 63.*
Examined:—Port Burwell, Quebec (Pere Dutilly 916) Sept. 25, 1936; also the type material.
On soil. Alaska, northern Quebec.

6. POLYTRICHUM NORVEGICUM Hedw. Sp. Musc. Frond. 99. *pl. 22. f. 1–4.* 1801.

Polytrichum Oederi Hedw. Sp. Musc. Frond. 99. 1801. As synonym.
Polytrichum crassisetum Lam. & De Cand. Fl. France (Ed. 3) 486. 1805.
Polytrichum septentrionale Beauv. Prodr. 86. 1805. Not of Brid. Mant. Musc. **4**: 198. 1819.
Polytrichum sexangulare Hoppe, Bot. Tasch. **1799**: 128. 1800. Also Web. & Mohr, Bot. Tasch. 220. 1807.
Polytrichum helveticum Schleich. Cent. Pl. Helv. 3, No. 16. 1815.
Polytrichum sexangulare var. *nivale* Kindb. Hewdigia **35**: 67. 1896.

Plants gregarious, forming a rather dense sod, bright-green to reddish-brown; stems 1–3–10 cm. long, simple or with few branches, 3-angled below, 5-angled where leafy; central strand 3-angled below, 5-angled to terete above; rhizoidous near base only; leaves grading into elamellose bracts below; the larger ones

patent when moist, closely imbricate when dry, linear-lanceolate to lanceolate from a sheathing base, up to 6 mm. long, stiff, the lower glossy; *apex blunt, cucullate; margin entire to shallowly few-toothed at tip, incurved to near sheath;* costa percurrent or slightly excurrent, with a few teeth at back close to tip or smooth; *lamellae* 30–50, *entire,* 4–6 cells high; *in cross section the marginal cells ovate-conical, very thick-walled specially on the outer wall, smooth;* cells of the median region of the leaf sheath rectangular, 38–57 μ long, 9–15 μ wide; cells of the unistratose border at ¾ up in distinct rows, squarish to oblong, 9–11 μ in longest diameter. Plants unisexual; male plants intermingled with the female; bracts subquadrate, an enlarged sheath with a triangular tip representing the limb; perichaetial leaves longer than the foliage leaves, with longer sheath; the innermost smaller, the limb reduced to an arista; calyptra shorter than the capsule, ferruginous; seta 1.5–4 cm. long, thick, twisted to right above, with cylindrical hollow, reddish-yellow; *capsule* erect or inclined, *obtusely 6-angled,* rarely 4-angled, reddish-brown; urn oval, about 1.5 mm. thick, 2–3 mm. long, neck constricted from capsule; lid about half as long as the urn, conic, with gradually narrowed beak; *epidermal cells of the capsule* small, squarish, thick-walled, *without a thin-walled central region;* stomata restricted to the neck, numerous, in 2–3 transverse rows, large, oval, 2-celled, the pore a long cleft; spore tissue with 6 or rarely 4 longitudinal ridges, with loosely filamentous tissue both interior and exterior to it; basal membrane about 120 μ high; teeth 64, unequal, about 120 μ long; spores 15–18 μ, smooth, yellow. Type locality, Norway.

Illustrations:—B. S. G. Bryol. Eur. *pl. 419;* Braithw. Brit. Moss Fl. **1:** *pl. 7A;* Hedw. Sp. Musc. Frond. *pl. 22. f. 1–4;* Proc. Wash. Acad. Sci. **12:** 231. *f. 26;* Dixon & Jam. Stud. Handb. Brit. Mosses (Ed. 3) *pl. 6E; Pl. 64A.*

Exsiccati:—Allen, Mosses Cascade Mts. 78; Holz. Musci Acro. Bor. Am. 271; Macoun, Can. Musci 585; Drumm. Musc. Am. 283 as *P. septenrionale.* C♯ MFI 25!

On rather barren soil at high altitudes. Greenland, Melville Island, Herald Island and Alaska, southward to Montana and Oregon; Europe; Asia.

Hedwig's capsule in Sp. Musc. Frond. must have been one which was immature. The leaf tip in his figure 4 is not that of *Pogonatum alpinum* var. *septentrionale,* but is the characteristic tip of the leaf of *Polytrichum sexangulare.* The short leaves of *P. sexangulare* are entire and have the blunt tip with a few teeth on the back. The one confusing thing in Hedwig's figures is the angularity in the capsule, but young capsules of all species of *Polytrichum* are terete. There is no other leaf tip like his figure 4. *P. sexangulare,* therefore, must give way to *P. norvegicum.*

Roell, in Hedwigia **35:** 67, 1896, publishes *Polytrichum sexangulare* var. *nivale* Kindb. as a new variety from Mt. Hood, Oregon. While Kindberg's material is not accessible to us, no one has since found this variety and considerable collecting has been done on Mt. Hood since 1888. Anyone well acquainted with *P. norvegicum* knows that the lower leaves are pointed and where they grade into the bracts they have distinct points. From these facts we are inclined to believe that he either had a stunted plant with only the lower leaves or examined leaves from the base of his plant.

7. Polytrichum juniperinum Hedw. Sp. Musc. Frond. 89. *pl. 18. f. 6–10.* 1801.

Polytrichum juniperifolium Web. & Mohr, Bot. Tasch. 219. 1807.
Polytrichum implicatum Voit. Musc. Frond. & Herbipolitano 59. 1812.
Polytrichum juniperinum var. *rubrum* C. Muell. Syn. Musc. Frond. **1:** 219. 1849.
Polytrichum juniperinum var. *alpinum* Schimp. Syn. (Ed. 1) 447. 1860.
Polytrichum behringianum Kindb. Rev. Bryol. **21:** 39. 1894.

Plants gregarious, in thin sods to almost solitary, *glaucous-green;* stems 2–4–10 cm. long, nearly always unbranched, 3-angled below, 5-angled above; *rhizoidous only at base;* leaves spreading when moist, erect when dry, lanceolate from a sheathing base, 8–10 mm. long, the limb about 1 mm. wide; *apex aristate, red, serrate; margin entire, widely incurved above the sheath;* costa excurrent, strongly toothed on back above; lamellae 35–48, finely crenulate by projecting cells, 4–8 cells high; *in cross section the marginal cells ovate-conical, very thick-walled specially on the outer wall, smooth;* cells of the leaf sheath long-rectangular, at the margin narrower and colorless; cells of the unistratose border at ¾ up in distinct rows, squarish. Dioicous; male plants intermingled with female ones, more slender, with shorter leaves; male bracts the enlarged leaf sheaths with triangular to cuspidate tip representing the limb; perichaetial leaves longer than the foliage leaves, up to 18 mm., with longer arista, their margins white and membranous; calyptra completely covering the capsule, whitish, or brownish only at tip; seta 2–5–11.5 cm. long, thick, slightly twisted to the right, with cylindrical hollow, bright red; capsule erect to horizontal, sharply 4-angled, yellowish green to brown; urn oblong,a bout 2.5 mm. thick, 3–5.5 mm. long, with a constriction above the hypophysis;

lid about ⅓ as long as the urn, shortly conic, with short beak; *epidermal cells of the capsule* mostly 5–6-angled, quite thick walled, *each with a thin-walled usually elongate central region;* stomata restricted to the hypophysis and constriction, in 2 transverse rows, large, of 2 or 4 cells; spore tissue with 4 longitudinal ridges, with loosely filamentous tissue both interior and exterior to it; peristome 300 μ long; basal membrane low, about 60 μ high; teeth 64, about equal, 50–60 μ wide, 160–180 μ long, blunt; spores 8–11 μ, smooth, yellow. Type locality, European.

Illustrations:—Rev. Bryol. **60:** *pl. 3–4;* Braithw. Brit. Moss Fl. **1:** *pl. 8B;* Dixon & Jam. Stud. Handb. Brit. Mosses (Ed. 3) *pl. 6B;* B. S. G. Bryol. Eur. *pl. 423;* Hedw. Sp. Musc. Frond. *pl. 18, f. 6–10;* Proc. Wash. Acad. Sci. **12:** 323. *f. 27;* Jennings, Man. Mosses W. Pennsylvania *pl. 29;* Grout, Mosses W. H-lens *pl. 12; Pl. 64B.*

Exsiccati:—Allen, Mosses Cascade Mts. 79; Aust. Musci Appal. 237; Bartram, Mosses S. Arizona 36; Crandall, Mosses Colorado. 30; Frye, Moss Exsic. 17, Bryo. Olympic Mts. 475; Grout, N. Am. Musci Perf. 17, Hand-lens Mosses 15; Holz. Musci Acro. Bor. Am. 75, 75c, 518 (as var. *alpinum*); Osborn, Bryo. Michigan 3329; Piper, Washington. Fl. 325, Pls. Priest Lake, Idaho, 342, 356; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 218; U. S. Soils Kelp Exped. Alaska 436, 515, 535, 565, 965, 1210, 1212, 1235, 1236, 1238.

On soil, more often in the sun than in shade. Greenland, Hudson Bay, Saskatchewan, Yukon and Alaska, southward to North Carolina, Wyoming, Utah, Arizona and California; Mexico; S. America; southern Oceanica; Europe; Asia; Africa; West Indies.

On mountains above the timber line it is smaller, narrower, the capsule almost as wide as long. This stunted form constitutes Schimper's variety *alpinum.*

7a. Var. alpestre B. S. G. Bryol. Eur. **21–22:** monog. 12. *pl. 424. g1–g5.* 1844.

Polytrichum alpestre Hoppe, Bot. Tasch. 198. 1801.
Polytrichum affine Funck, Hoppe Bot. Tasch. 43. 1802.
Polytrichum juniperinum var. *gracilius* Wahl. Fl. Lapp. 344. 1812.
Polytrichum juniperinum var. *strictum* Wallm., Liljebl. Svensk. Fl. (Ed. 3) 527. 1816.
Polytrichum strictum Brid. Bryol. Univ. **2:** 139. 1827.
Polytrichum juniperinum var. *affine* Fiedl. Syn. Laubm. Meckl. 96. 1844. Not of Roehl. Deutsch. Fl. **3:** 58. 1813.
Polytrichum strictum var. *alpestre* Limpr. Laubm. **2:** 630. 1895.

Plants in dense tufts, dark green; stems up to 20 cm. long; *rhizoids very numerous, matted, extending well up among the leaves,* sometimes within 2 cm. of the tip of the stem, brown to dirty yellow; leaves more distant, shorter, narrower; *margin entire;* costa toothed on back to near the sheath; lamellae 25–35. Capsule 1–1.25 times as long as wide. Type locality, European.

Illustrations:—B. S. G. Bryol. Eur. *pl. 424;* Jennings, Man. Mosses W. Pennsylvania *pl. 29* in part. Braithw. Brit. Moss Fl. **1:** *pl. 8C;* Schwaegr. Suppl. **1** (2): *pl. 97* in part; Dixon & Jam. Stud. Handb. Brit; Mosses (Ed. 3) *pl. 6C; Pl. 64B.*

Exsiccati:—Aust. Musci Appal. 238; Drumm. Musci Bor. Am. 281; Fernald & Weigand, Fl. Newfoundland 6473, 6492; Grout, Hand-lens Mosses 18; Holz. Musci Acro Bor. Am. 619; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 219; U. S. Soils Kelp Exped. Alaska 100, 457, 475, 1207, 1208, 1305.

In peaty bogs and on moors. Greenland to Alaska and Yukon, southward to North Carolina, Wyoming and Washington; S. America; Europe; Asia.

There seems to be no definite character upon which to base this except that the stem is rhizoidous up into the leaves.

7b. Var. Waghornei Kindb., Macoun Cat. Can. Pls. **6:** 155. 1892.

Stems not densely rhizoidous up into the leaves; *leaves somewhat serrate near tip;* marginal cells of the lamellae papillose. Type locality, Deep Water Creek, Venison Tickle and Cape Charles, Labrador (Rev. A. Waghorne).

On soil. Labrador.

I have been unable to see authentic var. *Waghornei.* It seems to me that specimens with stems not densely rhizoidous up into the leaves, with leaves slightly serrate near the leaf tip, belong here. More collections are desirable. On strongly incurved margins one would not expect serrations.

8. Polytrichum piliferum Hedw. Sp. Musc. Frond. 90. 1801.

Polytrichum pilosum Neck. Meth. Musc. 123. 1774.
Polytrichum Hoppii Hornsch. Flora **1**: 106. 1819.
Polytrichum pilifolium Gray, Nat. Arr. Brit. Pl. **1**: 720. 1821.
Polytrichum piliferum var. *Hoppei* Rabenh. Deutsch. Krypt.-Fl. **2** (3): 238. 1848.
Polytrichum laevipilum Hampe, Linnaea **30**: 459. 1859.
Polytrichum piliferum var. *laevipilum* Sull. & Lesq. Musci Bor. Am. (Ed. 2) No. 55.

Plants loosely caespitose, glaucous green to brown; stems 2–4–9 cm. long, *nearly always unbranched*, 5-angled; central strand in leafy part terete; its cells with irregularly thickened walls, subdivided by thin transverse walls, the outer 2–3 layers brownish; cortex of interior thin-walled cells which grade into the thick walled epidermis; rhizoids only at base; leaves spreading when moist, erect when dry, long-lanceolate from a sheathing base, up to 6 mm. long, the limb about 0.5 mm. wide; *apex ending in a long white sharply serrate arista* which is reddish at base; margin entire or merely crenulate by projecting cells, *widely incurved above the sheath* so the edges nearly meet; costa excurrent, smooth on back; lamellae 20–40, strongly sinuate or crenulate with projecting cells, 4–7 cells high, *in cross section the marginal cells ovate or flask-shaped, very thick-walled on the outer side, smooth;* cells of the leaf sheath rectangular, 2–2.5 times as long as wide in central region, hyaline at margin; cells of the unistratose border of the limb at ¾ up in rather indistinct rows, wider than long, rectangular. Plants unisexual; male plants with shorter leaf awns; male bracts mostly the sheath, obcordate, apiculate, lamellose only at tip; perichaetial leaves longer than the leaves; the inner thin, hyaline, without lamellae, long-aristate; calyptra covering the capsule, light-brown; seta 2–3.5 cm. long, flexuose, chestnut-brown to paler; capsule small, erect to inclined, sharply 4-angled; urn cubical to shortly prismatic, 1.5–2 mm. thick, 2–2.5 mm. long; neck constricted; lid depressed-conic, narrowed to a short beak, orange or red; annulus simple, persistent, of small cells; epidermal cells 4–6-angled, slightly wider than long to slightly longer than wide, with a large thin-walled central region; stomata in the neck, 2-celled, about 7 μ; spore tissue with 4 longitudinal ridges, with loosely filamentous tissue both interior and exterior to it; peristome a little more than 200 μ high; basal membrane very low, hardly projecting from the mouth; teeth 64, equal, small, blunt, about 200 μ long; spores 9–12 μ, smooth, yellowish green. Type locality, Germany.

Illustrations:—B. S. G. Bryol. Eur. *pl. 422;* Jennings, Man. Mosses W. Pennsylvania *pl. 28* in part; Proc. Wash. Acad. Sci. **12**: 327. *f. 30; Pl. 64C.*
Exsiccati:—Aust. Musci Appal. 239; Fernald & Wiegand, Fl. Newfoundland 6510; Frye, Bryo. Olympic Mts. 510, 590; Grout, N. Am. Musci Perf. 12, Hand-lens Mosses 17; Holz. Musci Acro. Bor. Am. 125; Macoun, Can. Musci 590; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 217, (Ed. 2) 55; U. S. Soils Kelp Exped. Alaksa 484; Drumm. Musc. Am. 278. Cf MF I. 25'
On rocky or sandy soil in dry places. Greenland to Alaska, southward to New Jersey, Ohio, Wyoming, Colorado, Utah, Nevada and California; S. America; Europe; Asia; Australia.

8a. Var. hyperboreum (R. Br.) C. Muell. Syn. **1**: 218. 1849.

Polytrichum hyperboreum R. Br. Parry's Voyage Suppl. 294. 1824.
Polytrichum boreale Kindb. Bih. K. Sv. Vetens.-Akad. Handl. **7** (9): 52. 1883.

Stem 3–12 cm. long, *mostly with tufted branches, laxly leafy*, red at base, leaf margin entire, or serrate only near arista; *arista* rough, *serrate, hyaline or somewhat reddish at base;* marginal cells of the lamellae often less thick-walled than in *P. piliferum.* Type locality, Melville Island.

Illustrations:—Proc. Wash. Acad. Sci. **12**: 326. *f. 29; Pl. 64C.*
Examined:—Port Burwell, Quebec (Pere Dutilly 1630) Sept. 25, 1936; Lake Tinderman, Yukon (Williams, 1902).
In northern or alpine regions not far from the summer snow line, in meadows. Greenland, Quebec, Melville Island, Yukon, and Alaska, southward to Labrador; Europe; Asia.

Note.—Dr. Frye has omitted to state that leaf sections of the Polytrichaceae must be made in the upper median portion of the non-sheathing part of the leaf in order to show characteristic lamella cells. The terminal cells of the lamellae are usually quite different near the base.—A. J. G.

CALYMPERACEAE.*

By William Campbell Steere, Ph. D.

Plants very small to large, growing in more or less extensive tufts *on the trunks or stumps of trees* (rarely on rock or soil); stem without a central strand. Leaves more or less sheathing, *bordered with a hyaline or yellowish margin* made up of narrow cells in one or more layers, or not bordered, with a margin one to several cells thick, *which sometimes bears lamellae;* costa with several rows of median guide cells, and two stereid bands, usually strong, disappearing just below the apex or shortly excurrent, *sometimes bearing propagula at the apex; the inner cells of the sheathing part large*, rectangular to quadrate, *smooth, thin-walled, hyaline*, comprising the *cancellinae*, which sometimes reach into the lamina; cells of the lamina small, green, usually strongly papillose. Dioicous, rarely autoicous; inflorescences apical, ♂ often lateral, gemmiform, with filiform paraphyses; perichaetial leaves usually little differentiated; seta erect, more or less elongated, rarely very short; capsule erect, usually *elongate-cylindric*, smooth or obscurely striate; stomata lacking; *annulus not differentiated;* peristome inserted below the mouth of the urn, simple *or lacking;* teeth 16, lanceolate, as a rule without conspicuous cross-markings, usually highly papillose and with rudimentary, hyaline membrane; *operculum usually long-beaked;* calyptra reaching to *or below* the base of the capsule, cucullate *or campanulate*, smooth or rough above, spores small.

Key to Genera.

1. Leaves with narrow, intra-marginal bands of differentiated, elongated cells (*teniolae*) 2–12 cells in from the margin (lacking in *C. Nashii*); calyptra persistent, campanulate ..... *2. Calymperes.*
1. Leaves without teniolae; bordered at the extreme margin with serrate wings or pale, elongated cells; calyptra cucullate ..... *1. Syrrhopodon.*

1. SYRRHOPODON Schwaegr. Suppl. 2²: 110. 1824.

Plants growing in compact, green to greenish-brown cushions with more or less radiculose, branching stems from a few mm. to 5–6 cm. high; leaves with imbricate, often conspicuously white base, mostly narrowed upward, varying from straight to crispate and from lanceolate to lingulate or ligulate, with acute or rounded apex, *and having a distinct border, either much thickened or with hyaline or yellowish, much-elongated cells;* costa stout, from nearly percurrent to excurrent, often papillose or spiny on one or both sides; leaf cells throughout upper part of leaf chlorophyllose and roundish or oval to quadrate, rarely smooth, mostly papillose or mamillose on one or both sides; cells of the erect base mostly hyaline (the *cancellinae*), square to linear, changing abruptly into the green cells of the upper part of the leaf. Dioicous or rarely autoicous; seta erect, elongate and smooth; capsule erect, regular, oval to cylindric, mostly smooth and glossy, chestnut-colored; annulus none; *peristome teeth (16) rarely wanting*, mostly narrowly lanceolate and undivided, sometimes very short and irregular, usually papillose and golden brown; operculum conical and often long rostrate; *calyptra cucullate, the base entire or somewhat split*, the apex often rough; spores usually rough; propagula and gemmae often produced by the leaves, usually growing at the apex and on the uppermost part of the costa, or rarely on the cells of the median leaf-blade on either side of the costa. Type species *Syrrhopodon Gardneri* (Hook.) Schwaegr.

Key to species of Syrrhopodon.

1. Leaf with very thick, doubly-serrate border of undifferentiated cells ..... 2.
   Leaf with hyaline or yellowish border of sharply differentiated, narrow, elongated cells ..... 3.
2. Costa more papillose (on the back) in the lower than in the upper half; peristome present ..... *1. S. floridanus.*
   Costa smoother (on the back) in the lower than in the upper half; peristome lacking *2. S. incompletus.*
3. Border extending from basal part to apex, often spinose-dentate ..... *3. S. texanus.*
   Border not extending to apex, not spinose-dentate ..... 4.

* Much of this study has been based upon Mr. R. S. Williams' revision of the Calymperaceae of North America, in Bull. Torr. Bot. Club **47**: 367–396. 1920. See also Bryol. **26**: 46; **26**: 47; **27**: 34–35.

4. Apex of leaves broadly rounded or retuse, entire; filamentous propagula lacking... *4. S. ligulatus.*
   Apex of leaves acute or obtuse, serrulate; filamentous propagula frequently present on upper median surface..... 5.
5. Terminal leaves lanceolate, 0.6–1.2 mm. wide..... *5. S. parasiticus.*
   Terminal leaves linear-lanceolate, 0.2–0.5 mm. wide..... *6. S. filigerus.*

S. prolifer Schwaegr. M F II 270 Florida

1. SYRRHOPODON FLORIDANUS Sull. in Gray, Manual. (Ed. II.) 631. 1856.

In dense, more or less extensive brownish-green cushions; stems branching, up to 3 cm. high; stem leaves incurved or crispate when dry, the upper 4–5 mm. long, from an ovate base, somewhat narrowed to a nearly linear point three to four times longer than the base, with incurved, *doubly serrulate-lamellate borders which often enclose a row of stereid cells* and broadly acute or obtuse serrulate apex; costa not quite percurrent, densely covered on the back, *from the middle to the broadened base* of the leaf, with *high* (*up to 8 μ*), almost spine-like papillae, leaf blade with cells highly mamillose on upper side, nearly smooth or somewhat mamillose on under side, with cells on upper blade distinct, mostly somewhat angular, *scarcely elongate*, 5–7 μ in diameter. Dioicous, perichaetial leaves not differentiated; pedicel erect, 7–8 mm. long; capsule ovate-cylindric, about 1.75 mm. long, the beaked operculum rather shorter; peristome teeth attached well below the mouth, somewhat irregular, short-lanceolate, pale; spores rough, about 16 μ in diameter. Type locality Florida.

ILLUSTRATIONS:—Sull. Icones Musc. *pl. 31;* Bull. Torr. Bot. Club **42**: *pl. 6*, **47**: *pl. 15, fig. 3; Pl. 65, 68.*
EXSICCATI:—Sull. et Lesq. Musc. Bor-Amer. (Ed. I), 113; Drummond, Musc. Amer. S. States 37 (as *S. albovaginatus*); Sull., Musc. Allegh. 171 (as *S. albovaginatus*); Austin, Musc. Appal. Suppl. I, 487; Holzinger, Musc. Acro. Bor.Am. 66; Grout, N. A. Musc. Perf. 48.
On the trunks of trees, especially palms. Very common in southern and western Florida, also occurring in Georgia, Alabama, Louisiana, and Long Island, N. Y. (*Wickes*).
This species can be confused only with the following, to which it is very closely related. However, the lower half of the costa is rougher on the back, the cells of the upper part of the leaf are less inclined to be slightly elongate, the border often encloses a row of stereid cells, and the peristome is usually present.

2. SYRRHOPODON INCOMPLETUS Schwaegr. Suppl. 2^1: 119. 1824.

S. Hobsoni Hook. et Grev. in Brewst. Edin. Jour. **3**: 224. 1824.
S. semicompletus Schwaegr., Suppl. 2^2: 97. 1827.
Calymperes Hobsoni Grev. Ann. Lyc. N. Y. **1**: 271. 1825.
Syrrhopodon Mohrii C. Müll. Linnaea **38**: 633. 1874.
S. brachystelioides C. Müll. Nuov. Giorn. Bot. Ital. II. **4**: 48. 1897.
S. decolorans C. Müll. Bull. Herb. Boiss. **5**: 188. 1897.

Plants in extensive, brownish-green mats with more or less curved and branching stems 1–5 cm. long; stem-leaves 4–5 mm. long, from a rather broad ovate or obovate base, which is serrulate on the margins above, abruptly narrowed to a broadly linear point, with *thickened, doubly-serrulate, homogeneous border* extending to the broadly acute or somewhat rounded serrulate apex; costa not quite percurrent, 60–70 μ wide one-half up leaf and about one-sixth the width of the leaf, denticulate at the apex, *from nearly smooth on both sides below to more or less papillose on the back, especially in the upper half;* cells throughout the upper part of the leaf from nearly square to hexagonal, *often slightly elongate*, the median mostly 5–6 μ wide and 6–8 μ long, mamillose on the under side; cancellinae filling two-thirds to three-fourths of the leaf-base. Dioicous; inner perichaetial leaves very similar to the stem leaves but smaller; seta 6–7 mm. long; capsule oblong-ovate, small-mouthed, rather over 2 mm. long without the lid, the beaked operculum about two-thirds as long; *peristome a rather pale, smoothish membrane not extending above the mouth, often nearly entire;* spores rough, 16–18 μ in diameter; calyptra slightly rough above. Type locality Cuba.

ILLUSTRATIONS:—Schwaegr. Suppl. 2: *pl. 180:* Bull. Torr. Bot. Club **47**: *pl. 15, fig. 4; Pl. 66, 68.*
EXSICCATI:—Krypt. Exsic. Musc. Palat. Vindob., No. 1896 (as *S. Hobsoni*).
On the trunks of trees, and on rotten wood. Rare and not usually well developed in Florida, but very common in the American tropics. Usually smaller than the preceding (in Florida).

3. SYRRHOPODON TEXANUS Sull. Musci U. S. 103. 1856.

S. alabamensis Lesq. et Schimp. Ber. St. Gall. Nat. Ges. **1877–78:** 413. 1879.

In green cushions with simple or slightly branching, stiff stems 2–5 cm. high; stem leaves more or less crispate when dry, erect-spreading when moist, the upper about 4 mm. long, linear-lingulate, or above often consisting of little more than the stout and very rough costa if bearing propagula, from a usually broader, ovate base, with obtuse, often *spiny-dentate* apex and *hyaline leaf-border* which is from *irregularly dentate to spiny-dentate* almost to the insertion of the leaf; costa stout, vanishing just below apex, *very rough on back* to below the cancellinae with *irregular, low, somewhat forking or spinose papillae;* cells of lamina variable roundish, obscure, 6–7 μ in diameter in upper leaf, perichaetial leaves very similar to upper stem-leaves; seta erect, *1–2 cm. long;* capsule ovate-cylindric, contracted at the mouth, about 2 mm. long, with slender beaked lid nearly as long; peristome short, lanceolate, obtuse, with two or three prominent articulations; calyptra descending to base of capsule; spores minutely punctate, about 14 μ in diameter. Type locality Texas.

ILLUSTRATIONS:—Sulliv. Icones Musc. Suppl. *pl. 20;* Bull. Torr. Bot. Club **47:** *pl. 16, fig. 16; Pl. 65, 68.*
EXSICCATI:—Austin, Musc. Appal. Suppl. I, 488; Holzinger, Musc. Acro. Bor. Am. 142.
Usually on trunks of trees or on rotten wood, but occasionally on rocks, or even on moist soil. Not uncommon in Texas, Florida and Georgia; also reported from Kentucky and Tennessee (*Sharp*); Long Island, N. Y. (*Cain*).
This is perhaps the easiest species of the genus to recognize, from the hyaline, serrate to spinose leaf-border. The spines are especially noticeable at the upper angles of the leaf-base. The verrucose or forked papillae on the back of the costa are also quite characteristic.

4. SYRRHOPODON LIGULATUS Mont. Syll. 47. 1856.

S. crispus Aust. Bot. Gaz. **2:** 109. 1877.

Growing in compact, brownish-green tufts with mostly simple stems up to 1.5 cm. high; stem-leaves with conspicuously white, imbricate base, *exceedingly crispate above when dry,* 2.0–2.5 mm. long from an obovate-lanceolate base, entire to serrulate, slightly narrowed to a lingulate, keeled point, from scarcely as long to about one and one-half times longer than the base, *with rounded and often emarginate apex,* which often bears small gemmae; *narrow, hyaline border* usually present *in the lower part of leaf;* costa nearly or quite percurrent, slightly serrulate on the back toward the apex, smooth below, about one-eighth the width of the leaf half way up; *cells of upper blade opaque and very obscure,* not elongate, 6–8 μ in diameter, mamillate and densely verrucose-papillose on both sides, making the upper leaf-margin sharply and finely denticulate; perichaetial leaves about like those of stem; seta 3–4 mm. long; capsule ovate, scarcely 1.0 mm. long; peristome teeth golden brown, projecting well above the mouth, rather rough, with indistinct articulations; spores rough, 12–15 μ in diameter; lid and calyptra not known. Type locality Guiana.

ILLUSTRATIONS:—Bull. Torr. Bot. Club **47:** *pl. 16, fig. 17; Pl. 66, 68.*
EXSICCATI:—Holzinger, Musc. Acro. Bor. Am. 474.
On trees, rare. Known in the United States only from southernmost Florida. Pensacola, Fla. (McFarlin)
The truncate, often emarginate leaves of this rare species serve to distinguish it from all others.

5. SYRRHOPODON PARASITICUS (Sw.) Besch. Ann. Sci. Nat. VIII. **1:** 298. 1895.

Bryum parasiticum Sw. Prodr. Fl. ind. Occ. 139. 1788.
Encalypta parasitica Sw. Fl. ind. Occ. **3:** 1759. 1806.
Calymperes parasiticum (Sw.) Hook. et Grev. in Brewst. Edin. Jour. **1:** 131. 1824.
Calymperopsis parasitica (Sw.) Broth. Engl.-Prantl, Pflanzenfam. (Ed. 2). **10:** 235. 1924.

Plants scattered or in loose tufts, large, stems up to 2 cm. high, stem leaves usually 4–5 mm. long, linear-lanceolate, the basal part often slightly narrower than the upper part, *the terminal leaves much shorter and broader, lanceolate to ovate-lanceolate, up to 1 mm. wide and occasionally broader,* rather gradually acutely pointed, subtubulose and erect-flexuose when dry, widely spreading, *almost squarrose when moist,* with a *yellowish minutely serrulate or entire* border of elongated cells (sometimes lacking in the terminal leaves) extending from about one-third below the apex nearly to the base; costa nearly percurrent, smooth at the back, except at the slightly denticulate apex; cells in the upper part of the blade mamillose on upper, smooth or unipapillate on the under side, mostly hexagonal, the median about 8 μ wide and 8–10 μ long, those on

the upper side next the costa often bearing, *from some distance below the apex to near the cancellinae, filiform propagula* about 0.5 mm. long, with fifteen to twenty cross-walls. Dioicous; perichaetial leaves scarcely differentiated; seta (with vaginule) 3.5 mm. long, bearing an erect cylindric capsule 1.5–1.7 mm. long; capsules usually clustered; peristome consisting of 16 irregular teeth hardly projecting above the rim of the capsule; operculum conic with a filiform beak about two-thirds the length of the capsule; calyptra cucullate, finely plicate, deeply split on one side; spores green, minutely granulose, oval. Type locality Haiti.

Illustrations: Schwaegr. Suppl. **1:** *pl. 17;* Bryol. **26:** 46 (50), *fig. 1–9;* Bull. Torr. Bot. Club **47:** *pl. 16, fig. 18; Pl. 66, 68.*

Exsiccati:—Holzinger, Musc. Acro. Bor.-Am. 498.

On the bark of trees and shrubs. Occasional in southern Florida, but only rarely fruiting.

The broad terminal leaves which often bear elongate, septate propagula separate this species from all the others but the following, which is smaller and has narrower terminal leaves.

6. Syrrhopodon filigerus (Aust.) Williams, Bull. Torr. Bot. Club **47:** 384. 1920.

Calymperes filigera Aust. Bot. Gaz. **4:** 151. 1879.
Calymperopsis filigera (Aust.) Broth. Engl.-Prantl, Pflanzenfam. (Ed. 2). **10:** 235. 1924.

In small green cushions with stems short, 3–6 mm. high; leaves 2.5–4.0 mm. long, incurved or very slightly crispate when dry, linear from an oblong base, with an acute or somewhat obtuse, serrulate apex; costa percurrent, sometimes *bearing numerous filiform propagula throughout the middle part; border short,* rarely extending above the middle and *often lacking in the lower part,* composed of a *yellowish,* cylindric band of elongated, thick-walled cells; cells of blade translucent, mamillose on the upper side, finely papillose on the under side, slightly elongate, somewhat angular, the median 7–8 μ wide and 8–10 μ long. Apparently dioicous; seta (with vaginule) 2.5–3.0 mm. long, bearing an erect, ovate-cylindric capsule, 1.3–1.5 mm. long, contracted at the mouth; operculum long-rostrate, with a beak about 0.5 mm. long; peristome apparently lacking; calyptra cucullate, faintly plicate. Type locality Florida (*Austin*).

Illustrations:—Bull. Torr. Bot. Club **47:** *pl. 16, fig. 19; Pl. 66, 68.*

Known only from the type locality (Caloosa) and from Oviedo, Florida (*S. Rapp*). Although the type collection was sterile, Rapp's material bears fruit, thus making it possible, for the first time, to describe the sporophytic characters.

2. CALYMPERES Sw. in Weber f. Tab. Calypt. Operc. Musc. Frond. 1813; in Schwaegr. Suppl. **1²:** 333. 1816.

Plants small to medium sized, growing in compact tufts with erect, often dichotomous stems; stem leaves when dry mostly strongly incurved or crispate and subtubulose above the erect, clasping, usually broader and conspicuously white base, the leaf point varying from lanceolate to lingulate or ligulate with apex often broad; costa stout, vanishing just below the apex or more or less excurrent, *often enlarged and bearing propagula in dense clusters at the apex,* from smooth to rough on both sides, sometimes spinose; leaf margin usually more or less thickened and serrate or rarely with two serrate wings; *ribbon-like bands of green, elongated cells, the teniolae* (lacking in one species), *extend, just within the margin, from base to near apex* in some species, in others only for a short distance in the upper basal part of the leaf; cells of the upper blade roundish to angular, sometimes shortly elongate, chlorophyllose, often rather obscure, mostly mamillose on the upper side and smooth to somewhat mamillose and often papillose on the under side; hyaline, rectangular or nearly square cells of the *cancellinae* usually filling most of the basal or sheathing part of the leaf, except a narrow border, and changing abruptly into the green cells of the blade above. Dioicous; *peristome none;* capsule oblong to cylindric, smooth, on an erect, more or less elongate seta; *calyptra persistent, plicate,* rough in upper part, *embracing the base of the capsule and split on the sides only part way down to the base.* Type species *Calymperes lonchophyllum* Schwaegr.

Key to the Species of Calymperes

1. Teniolae absent ..... *1. C. Nashii.*
   Teniolae present in at least the leaf-base ..... 2.
2. Green cells about 4 μ in diameter, margin very thick and strongly serrate ..... *4. C. Donnellii.*
   Green cells 6–8 μ in diameter, margin not much thickened ..... 3.

3. Teniolae only 2–3 rows in from margin in upper leaf-base, upper half of blade entire *2. C. Richardi.*
Teniolae 4–8 rows of cells in from margin in upper leaf-base, upper leaf blade and apex serrate ..... *3. C. emersum.*

1. Calymperes Nashii Williams Bull. Torr. Bot. Club **47**: 391. 1920.

In very thin, dusky green cushions with stems only 2 or 3 mm. high; leaves strongly incurved or crispate when dry, about 2.5 mm. long, oblong-linear from a slightly or not at all broader base; *leaf entire, with a thick, cylindric border of short-rectangular, green cells* extending from a little below the apex to the erect or clasping basal part; costa nearly cylindric, about 65 μ wide one-third up from base, papillose on both sides to cancellinae, usually shortly excurrent, slightly enlarged at the apex and bearing numerous short, spindle-shaped propagula *about 120 μ long, with six to eight transverse walls;* leaf cells of spreading blade mostly not elongate, the median 4–6 μ in diameter, mamillose on upper side, slightly or not mamillose but more or less papillose on under side; *teniolae wanting;* cancellinae extending about one-fourth up the leaf; fruit unknown. Type locality Haiti.

Illustrations:—Bull. Torr. Bot. Club **47**: *pl. 17, fig. 8; Pl. 67, 68.*
Known in the United States only from the extreme southern part of Florida (Dade County).
This species seems to be very close to the following, *C. Richardi,* but the stems are shorter, the teniolae are lacking, the leaf-border is entire and the cancellinae are narrower; otherwise it could be very easily taken for a species of *Syrrhopodon.*

2. Calymperes Richardi C. Müll. Syn. **1**: 524. 1849.

C. Breutelii Besch. Ann. Sci. Nat. VIII. **1**: 278. 1895.
C. guadalupense Besch. Ann. Sci. Nat. VIII. **1**: 285. 1895.
C. hexagonum Besch. Ann. Sci. Nat. VIII. **1**: 286. 1895.
C. Hookeri Besch. Ann. Sci. Nat. VIII. **1**: 287. 1895.
C. panamae Besch. Ann. Sci. Nat. VIII. **1**: 298. 1895.

In compact cushions with stems sometimes branching, 5–6 mm. high or rarely up to 2 cm.; *leaves strongly incurved or crispate when dry, the lower short, ovate, about 0.75 mm. wide by 1.5 mm. long,* the upper 3.0–4.5 mm. long from a variable base, sometimes distinctly ovate or obovate and considerably wider than the blade above, sometimes scarcely or not wider than above, and extending into a broadly acute or obtuse point, or those leaves bearing propagula narrowed above into a stout point of variable length, with rounded apex; leaf margin entire except along the upper part of the clasping base, which is more or less irregularly serrulate; costa stout, vanishing just below the apex, rough on both sides above, slightly rough or smooth below the middle and bearing at the apex *on the upper side only* a dense cluster of narrowly spindle-shaped propagula, *up to 250 μ long with ten to fifteen cross-walls;* cells of upper leaf mamillose, distinct, mostly roundish, 6–8 μ in diameter; *teniolae two or three cells wide and one to five cells in from the lower margin, extending from the upper part of the leaf-base and running into the thickened border toward the apex of the leaf;* cancellinae extending one-third to one-fourth up the leaf; perichaetial leaves much like stem-leaves, but larger below, with cancellinae extending higher up; seta erect, about 3 mm. long; capsule 1.5 mm. long, elongate-oval, smooth, without peristome; lid short-rostrate; spores rough, up to 35 μ in diameter. Type locality Guiana.

Illustrations:—Bull. Torr. Bot. Club **47**: *pl. 17, fig. 1;* Prodr. Fl. Bryol. Surimam., *pl. 3*; *Pl. 67, 68.*
Exsiccati: Austin, Musc. Appal. Suppl. I, 489; Grout, Musc. Perf. 323.
On the bark of trees and shrubs. Although only occasionally found in Florida, this is apparently the most common species of the genus in the United States.
It is readily distinguished by the very short and broad basal leaves and by the elongated apical leaves, in well developed plants, which often bear a terminal brush-like group of fusiform propagula.

3. Calymperes emersum C. Müll. Bull. Herb. Boiss. **5**: 189. 1897.

In broad, lax, dull-green tufts with stems about 1.5 cm. high; stem leaves about 4 mm. long, mostly incurved, *often scarcely crispate when dry,* from a somewhat wider, or in the lower leaves narrower, oblong or obovate, serrulate base extending into a broad, oblong-linear point, from not much longer than the basal

part to about twice longer, with rather abruptly acute, serrulate apex and costa vanishing just below apex or when bearing propagula, excurrent and enlarged into a stout rough point, *with the propagula on all sides* near the apex; costa in the middle of the leaf about one-tenth the width of leaf, rough on both sides in upper half; blade of leaf highly mamillose and papillose on the upper side, the under side not mamillose but finely papillose; cells throughout spreading leaf blade distinct, scarcely or not elongate, angular to roundish, 7–8 μ in diameter, with one or sometimes two papillae on each surface; *teniolae extending from or near the base to near the abruptly narrowed apex and only one or two cells in from the margin in the upper part of the leaf, but four to eight cells in from margin at the broadest basal part; cancellinae often extending nearly one-half up leaf next the costa; capsule scarcely emergent.* Type locality, Guatemala.

ILLUSTRATIONS:—Bull. Torr. Bot. Club **47**: *pl. 17, fig. 3; Pl. 67, 68.*
EXSICCATI:—Grout, Musc. Perf. 322.
Known only from the type locality and from two stations in southern Florida, Deering Hammock (*Small*) and Hattie Bauer Hammock (*Grout*), both in Dade County, and in Myaka City, Manatee Co., Florida.
This rare species is distinguished from the preceding by the somewhat longer stem-leaves from a wider base, which bear propagula on all sides of the costa. Also, the teniolae extend farther toward the leaf insertion.

4. CALYMPERES DONNELLII Aust. Bot. Gaz. **4**: 151. 1879.

C. rufescens Besch. Ann. Sci. Nat. VIII. **1**: 302. 1895.
C. Brittoniae Besch. Ann. Sci. Nat. VIII. **1**: 278. 1895.
C. Smithii Besch. in Par. Ind. Musc. (Ed. I.) 1255. 1898.
C. portoricense Ren. et Card. Bull. Soc. Bot. Belg. **41** (1): 57. 1904.
C. Richardi C. Müll. var. *Donnellii* Lesq. and James Man. 184. 1884.

In extensive green mats with stems from 3 mm. to 1 cm. high; *leaves incurved or crispate when dry*, the lower 2.5–3.0 mm. long, the upper about 5 mm. long, from a mostly slightly broader, more or less ovate base one-third to one-fourth the entire length of the leaf, extending into an oblong-linear blade with broadly acute apex, or those bearing propagula usually abruptly narrowed to a rough stout point of variable length; *leaf margins incurved, doubly and irregularly serrate above, with thickened margin*, below minutely serrulate; costa stout, often very rough on inner face above, and on back from apex to near the cancellinae; cells throughout upper leaf mamillose and papillose, *roundish, mostly 4–5 μ in diameter, teniolae distinct to the insertion of the leaf, eight to twelve cells in from the margin in the broadest part of the leaf, extending about one half up leaf and disappearing in the thickened broder;* cancellinae extending one-third to one-fourth up leaf; perichaetial leaves few, *only about one-half as long as upper stem-leaves*, enclosing numerous, very long paraphyses; seta dark red, erect, 5 mm. long; capsule cylindric, about 2 mm. long; calyptra scabrous above, spores rough, about 18 μ in diameter. Type locality Caloosa, Florida.

ILLUSTRATIONS:—Bull. Torr. Bot. Club **47**: *pl. 17, fig. 5; Pl. 67, 68.*
Known in the United States from central and southern Florida, from sterile material only.
The exceedingly small cells and the doubly serrate leaf-margins make it possible to separate this species readily from its congeners.

* Omitted by mistake from page 90. Adapted from N. Am. Flora **15**[2]: 136. 1913.

CAMPYLOPUS SCHIMPERI Milde, Crypt.-Fl. Süd-Tirols (Bot. Zeit. Beil.), 13. 1864.

Campylopus frigidus Lesq. in Porter and Coult. Syn. Fl. Colo. 155, in part. 1874.
Leptotrichum tomentosum Kindb. Ottawa Nat. **7**: 18. 1893.

Plants in compact tufts, 2–3 cm. high, with stems reddish-tomentose below and yellowish-brown at the summit; leaves about 3 mm. long, closely appressed when dry, gradually lanceolate from an oblong base, tubulose above, entire on the margin to near the apex; costa excurrent nearly half its length, more or less ribbed on the back, about 120 μ wide near the base and extending two-thirds across the leaf-base, *without stereid-bands*, in cross-section showing a row of large, thin-walled cells on the ventral side with 2 or 3 rows of smaller cells beneath; alar cells red to hyaline, the cells just above pale, thin-walled, rectangular, toward the margin very narrow, farther up all more or less oblong to oval and rhomboidal with slightly thickened, scarcely or not pitted walls.

Type locality: Europe.

Arctic-alpine, on rocks and soil: Greenland, St. Paul Island, Alaska, Rocky Mountains of Colorado, also in Europe.

ILLUSTRATIONS: Dixon's Handbook British Mosses. Ed. 3, plate 11 L: Braithw. Brit. Moss Flora, V. **1:** *plate 18 C; Pl. 48 E.*

PLATE 39. *A*. *Angstroemia longipes* (from Bry. Eur. *pl. 94*). 8, upper stem leaf; 8*a*, 8*b*, apical and basal leaf cells of the same; 10, 11, perigonial leaf, antheridia and paraphyses; 14, perichaetium; 15, 16, 17, perichaetial leaves in order; 15*a*, apex of perichaetial leaf; 19, 20, 28, cpasules; 22, 23, opercula; 24, 25, 26, peristome teeth.

B. *Rhabdoweisia denticulata* (from Bry. Eur. *pl. 42*). 5, 9, leaves; 5*a*, 5*b*, apical and basal cells of 5; 12–15, capsules; 16, portion of peristome; 17, lateral view of peristome tooth.

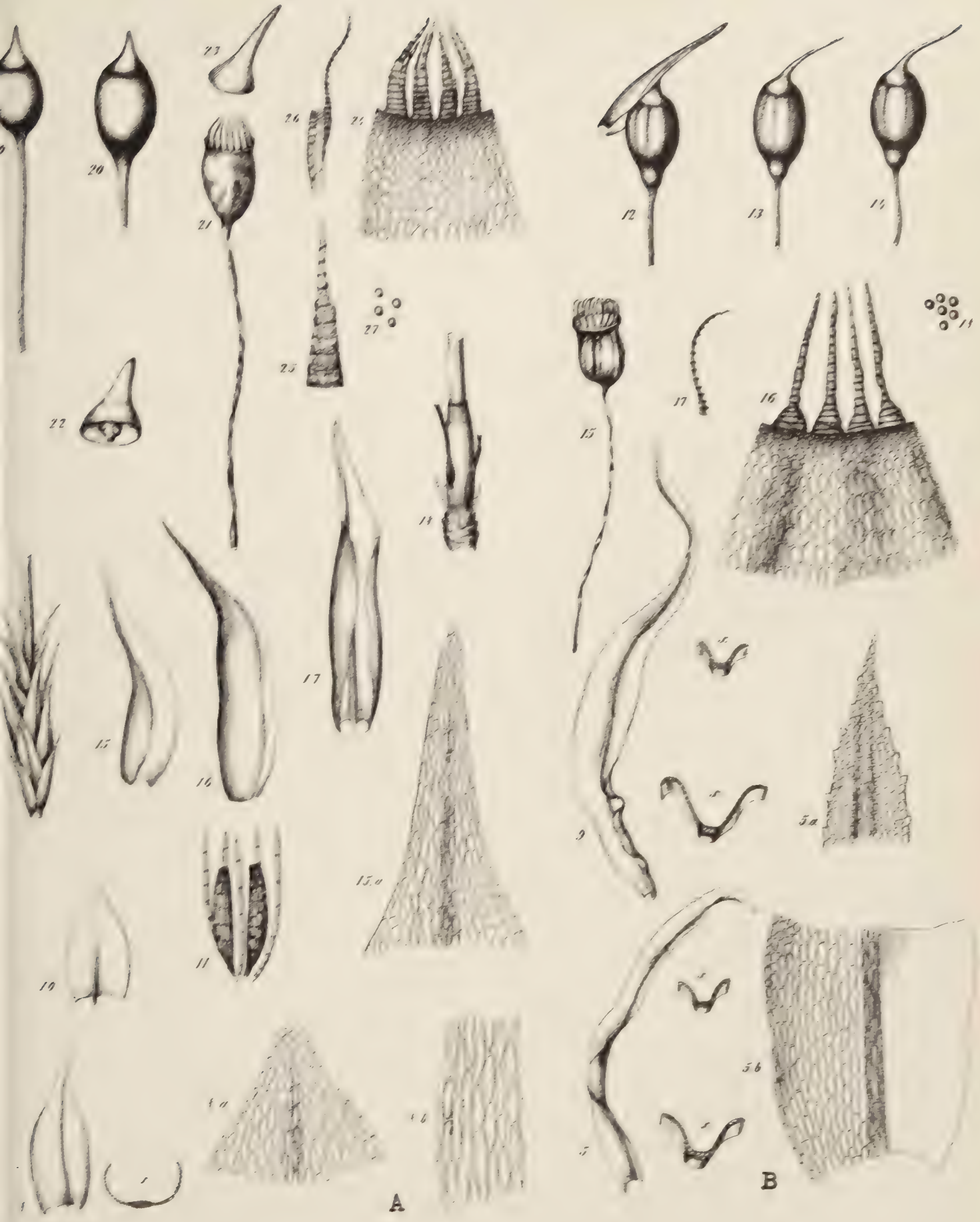


PLATE XXXIX.

PLATE 40. *A*. *Oreoweisia serrulata* (from Bry. Eur. *pl. 27*). 7, 8, 9, 11, leaves; 10, inflorescence; 7*a*, 9*a*, leaf apices; 9*b*, leaf base; 9*ax*, portion of leaf showing papillae; 14, 16, capsules; 17–19, peristome teeth.

B. 16–19, capsule and peristome of *Rhabdoweisia fugax* (from Bry. Eur. *pl. 41*).

D. *Dichodontium pellucidum* (from Braithw. Brit. Moss Fl. *pl. 24D*). For description see plate 42*C*.

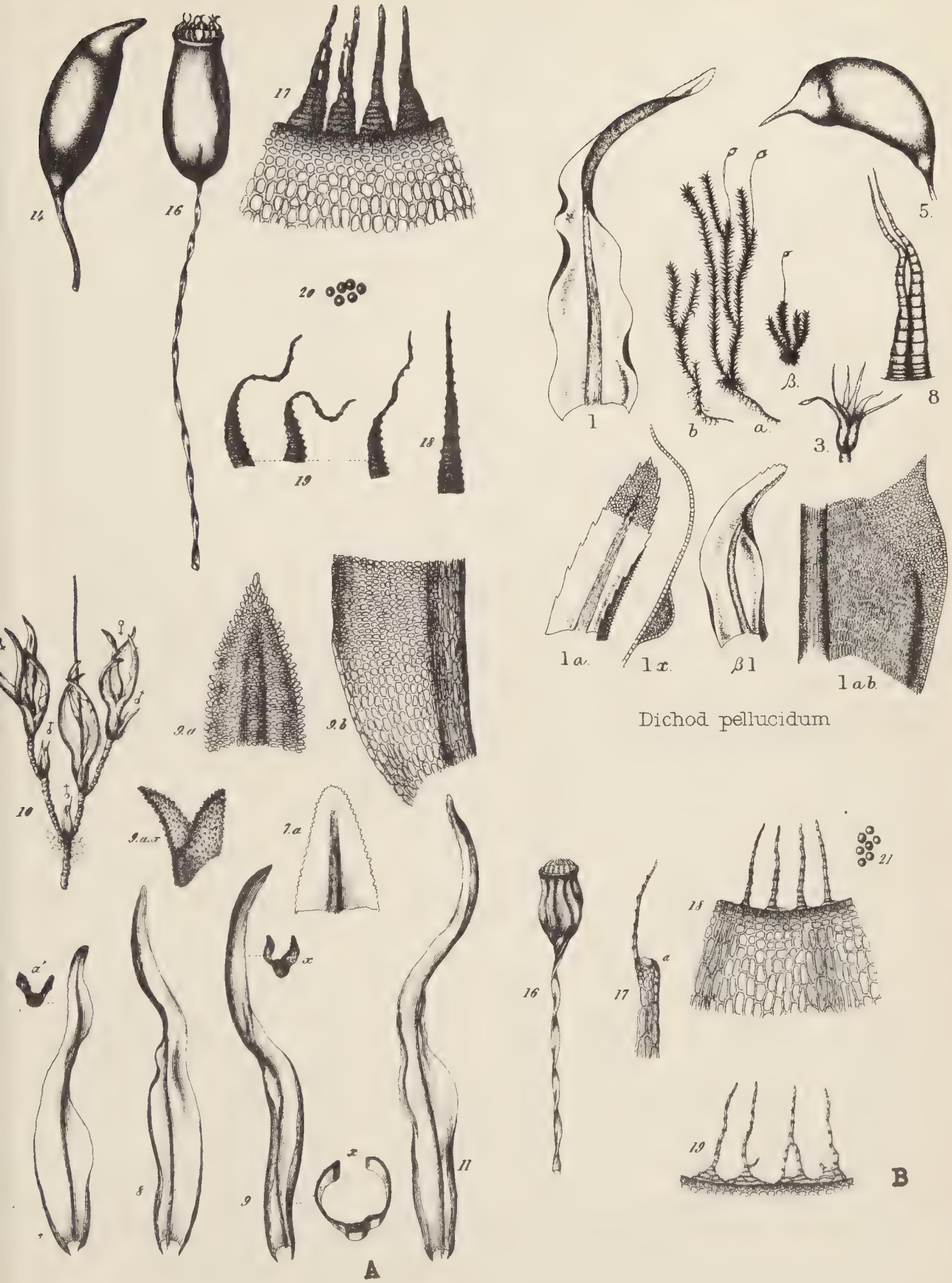

14
16
17
20
19
18
1
b
a.
β.
3.
5.
8
1a.
1x.
β1
1ab.
Dichod pellucidum
10
9.a.x
9.a
9.b
7.a
x'
x
7
8
9
x
11
A
16
17
a
18
21
19
B

PLATE XL.

PLATE 41 (upper part). *A. Dichodontium olympicum* (from Bot. Gaz. **30**: *pl. 2*). *a*, plant, × 1; *b*, *b*, *b*, leaves, × 32; *c*, basal areolation, × 135; *d*, marginal areolation in the upper part, × 260; *e*, cross section of the costa, × 260; *f*, capsule, × 26; *g*, peristome tooth, × 105; *h*, upper portion of the same, × 285.

B. Oncophorus Jenneri (from Dixon, Handb, Brit. Mosses *pl. 10A*, by permission). Leaf, × 15; leaf cells about ⅓ from apex, × 180; cross section of leaf, × 180; dry and empty capsule, × 10.

Lower part (from Broth. Laubm. Fennoskand. *f. 15*, by permission). *A–D. Oncophorus Schisti*. *A*, plant, × 1; *B*, stem leaf, × 22; *C*, apex of same, × 125; *D*, peristome. *E–J. Oncophorus alpestre*. *E*, fruiting plant; *F*, stem leaf; *G*, leaf apex more enlarged; *H*, capsule; *J*, peristome. *K–N. Oncophorus tenellus*. *K*, stem leaf; *L*, apex of the same; *M*, capsule; *N*, peristome.

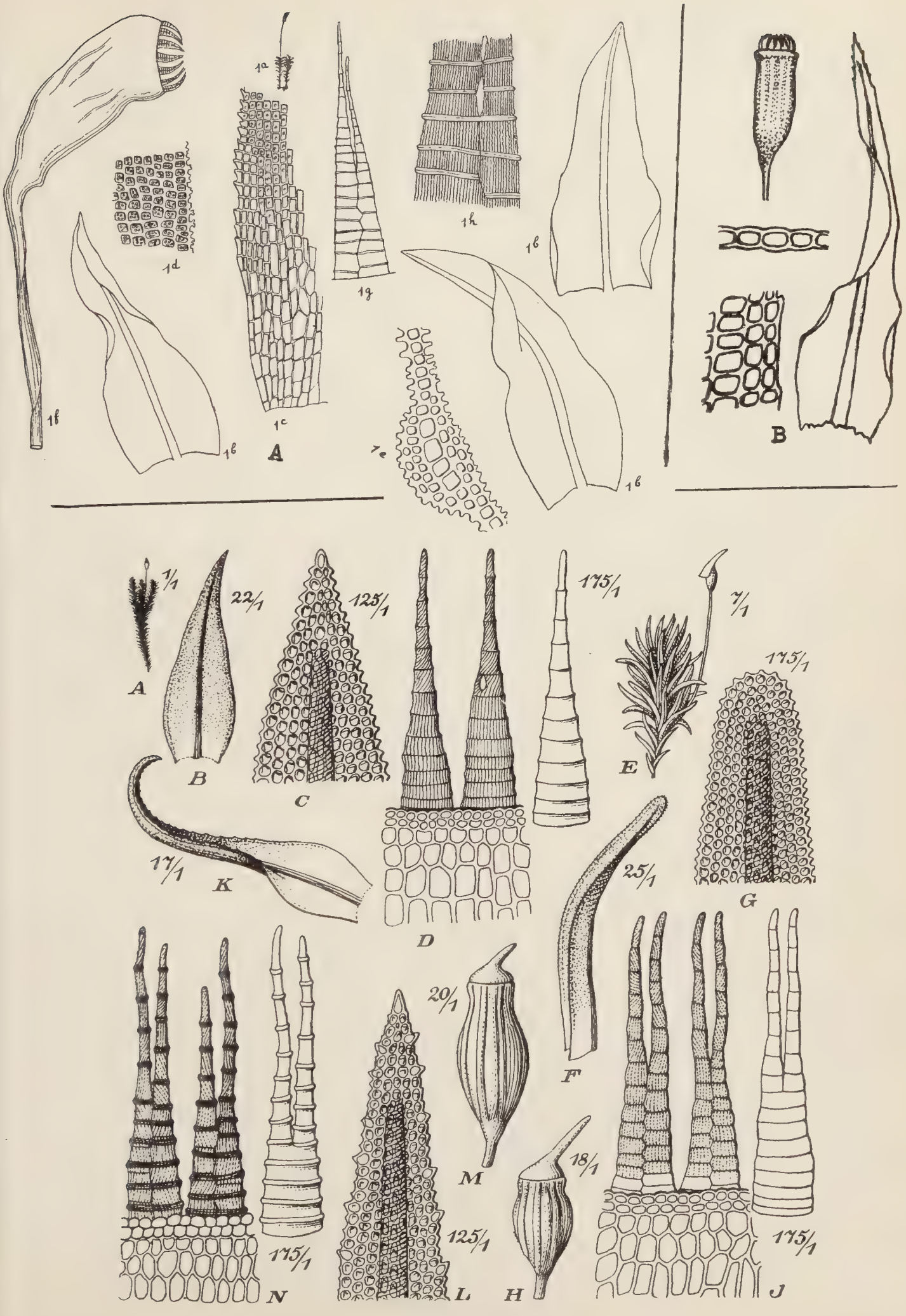

1a
1b
1c
1d
1e
1f
1g
1h
A
B
1/1
22/1
125/1
175/1
7/1
175/1
A
B
C
D
E
G
17/1
K
25/1
F
20/1
M
18/1
125/1
175/1
175/1
N
L
H
J

PLATE XLI.

PLATE 42. *A*. *Dicranoweisia subcompacta* (from Bot. Gaz. **30**: *pl. 11*). *a*, plants, × 1; *b*, *b*, leaves, × 32; *d*, median and *e*, apical areolation, × 135.

C. *Oncophorus polycarpus* var. *strumiferus*. *a*, fertile plant, × 1; 1, leaf enlarged; 1*x*, cross section of leaf; 1*aa*, leaf apex; 1*ab*, areolation of base; 2, perichaetial leaf; 3, male bud; 4, perigonial bract, antheridium, and paraphyses (3, 4 and 8 not found in *C*); 5, capsule; 8, peristome.

B, *D*, *E*, as indicated, description as in *C*. (*B*–*E* from Braithw. Brit. Moss Fl. 1: *pl. 25*).

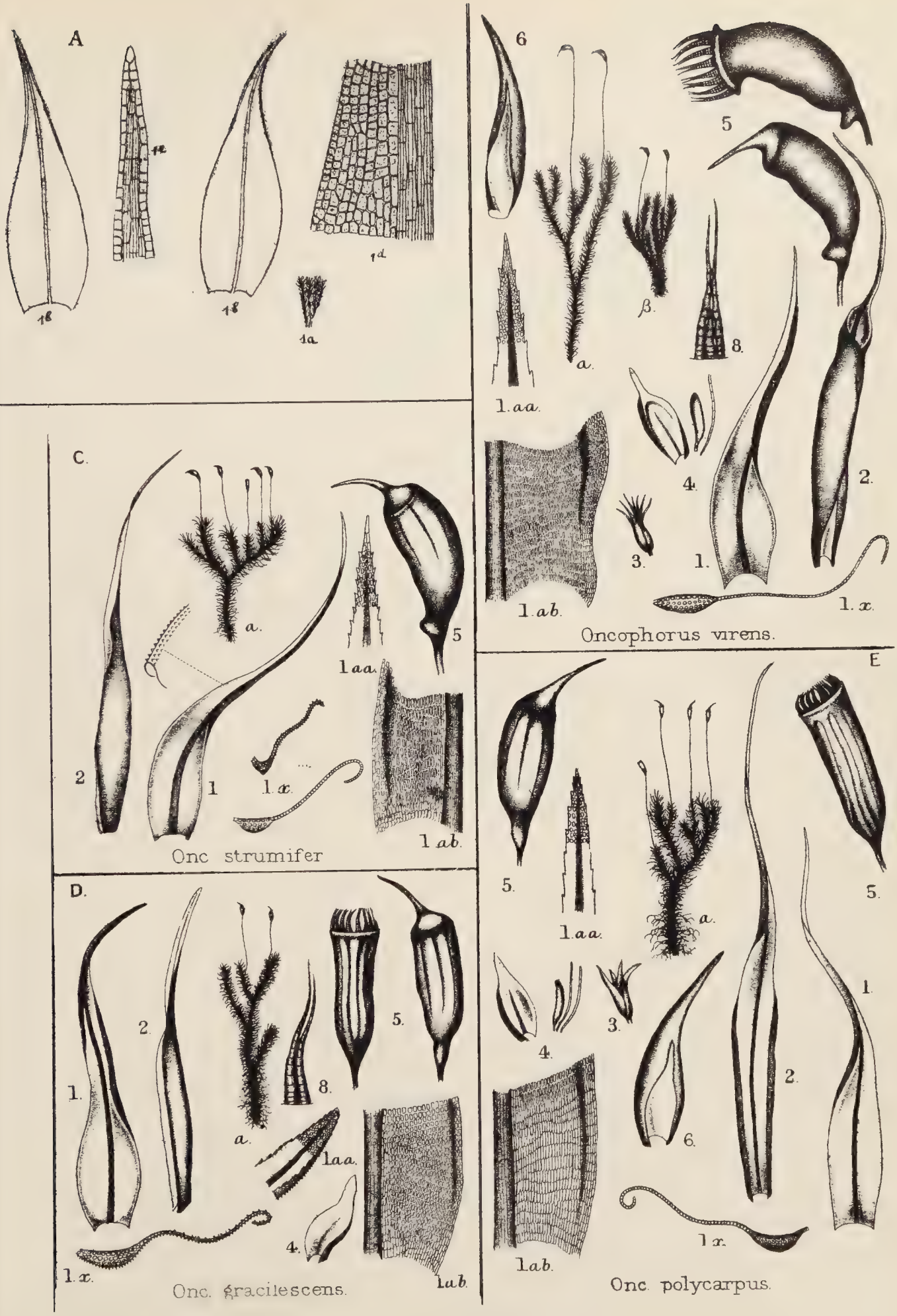
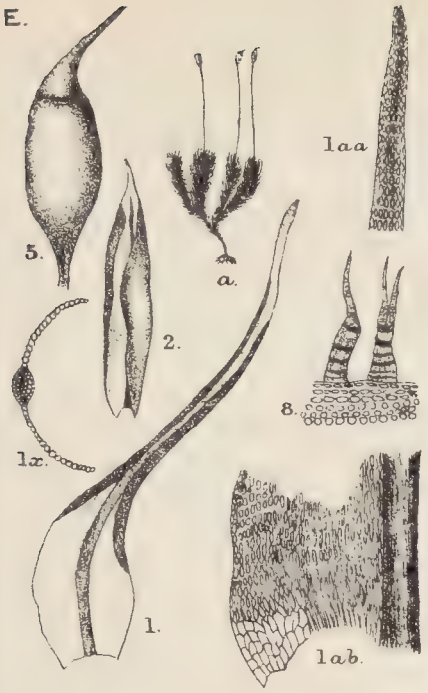

A
1c
1b
1d
1a
6
5
β.
a.
8.
1.aa.
4.
2.
3.
1.
1.ab.
1.x.
Oncophorus virens.
C.
a.
5
1aa.
2
1
1.x.
1.ab.
Onc strumifer
E
5.
1.aa.
a.
5.
4.
3.
1.
2.
6.
1.x.
1.ab.
Onc. polycarpus.
D.
1.
2.
a.
8.
5.
1aa.
4.
1.x.
1.ab.
Onc. gracilescens.

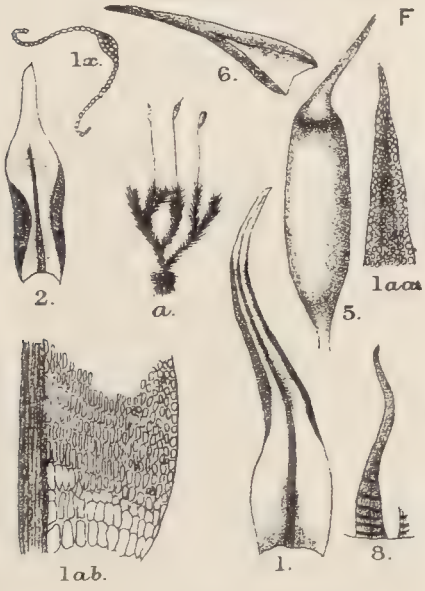
PLATE XLII.

PLATE 43. *E*, *F*, *G*, on left margin from Braithw. Brit. Moss Fl. 1: *pl. 19*. Species as indicated; description under *pl. 42*.

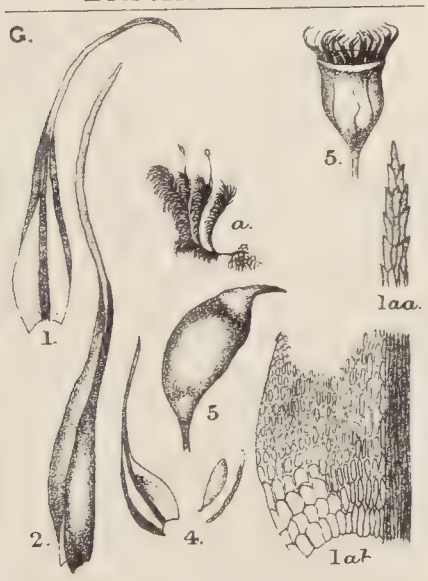
On the right, Dixon, Handb. Brit. Mosses *pl. 13* (by permission). Species as indicated, description under *pl. 46*.



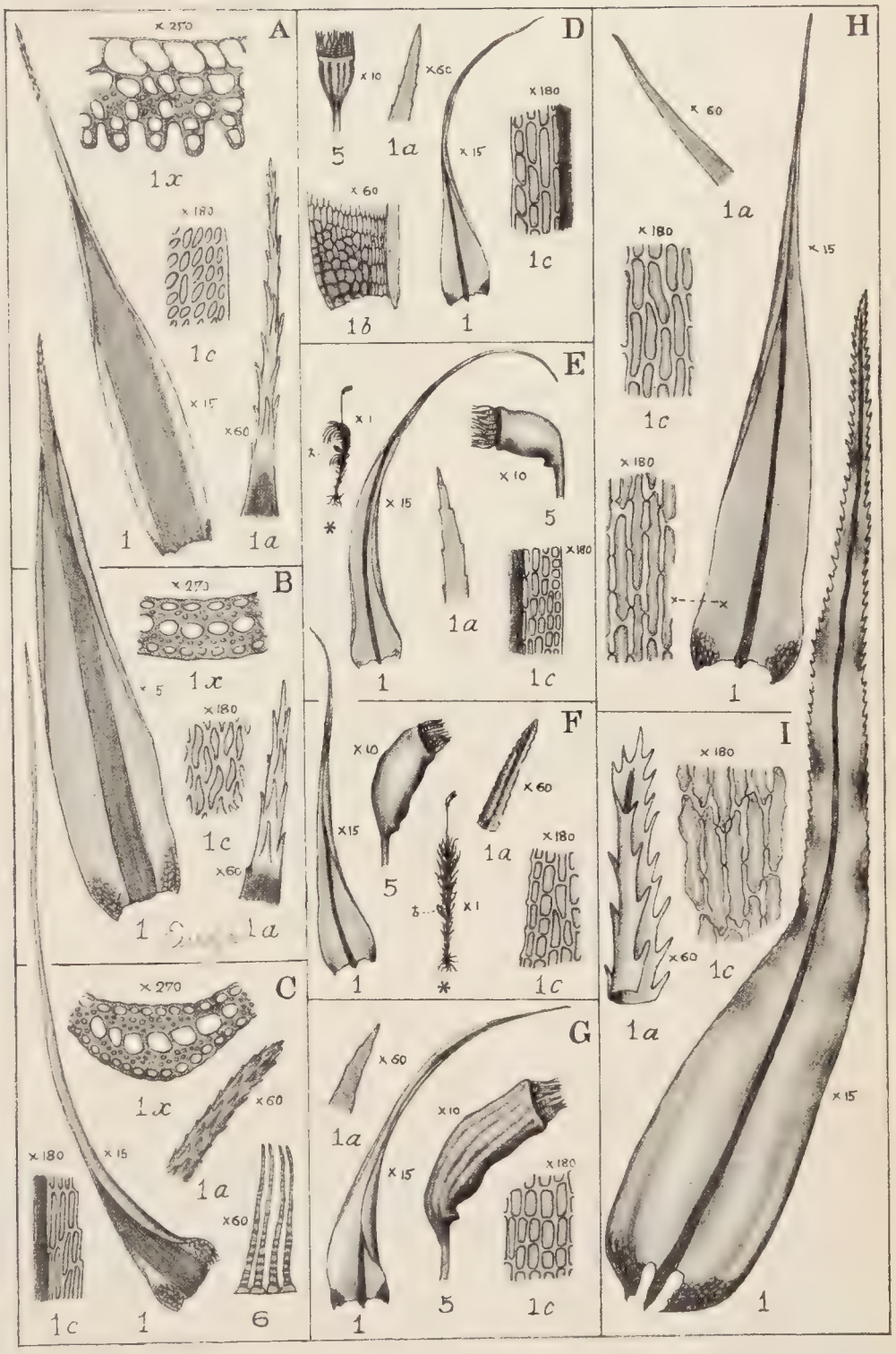
Dicranow. crispula.



Dicranow. cirrata.



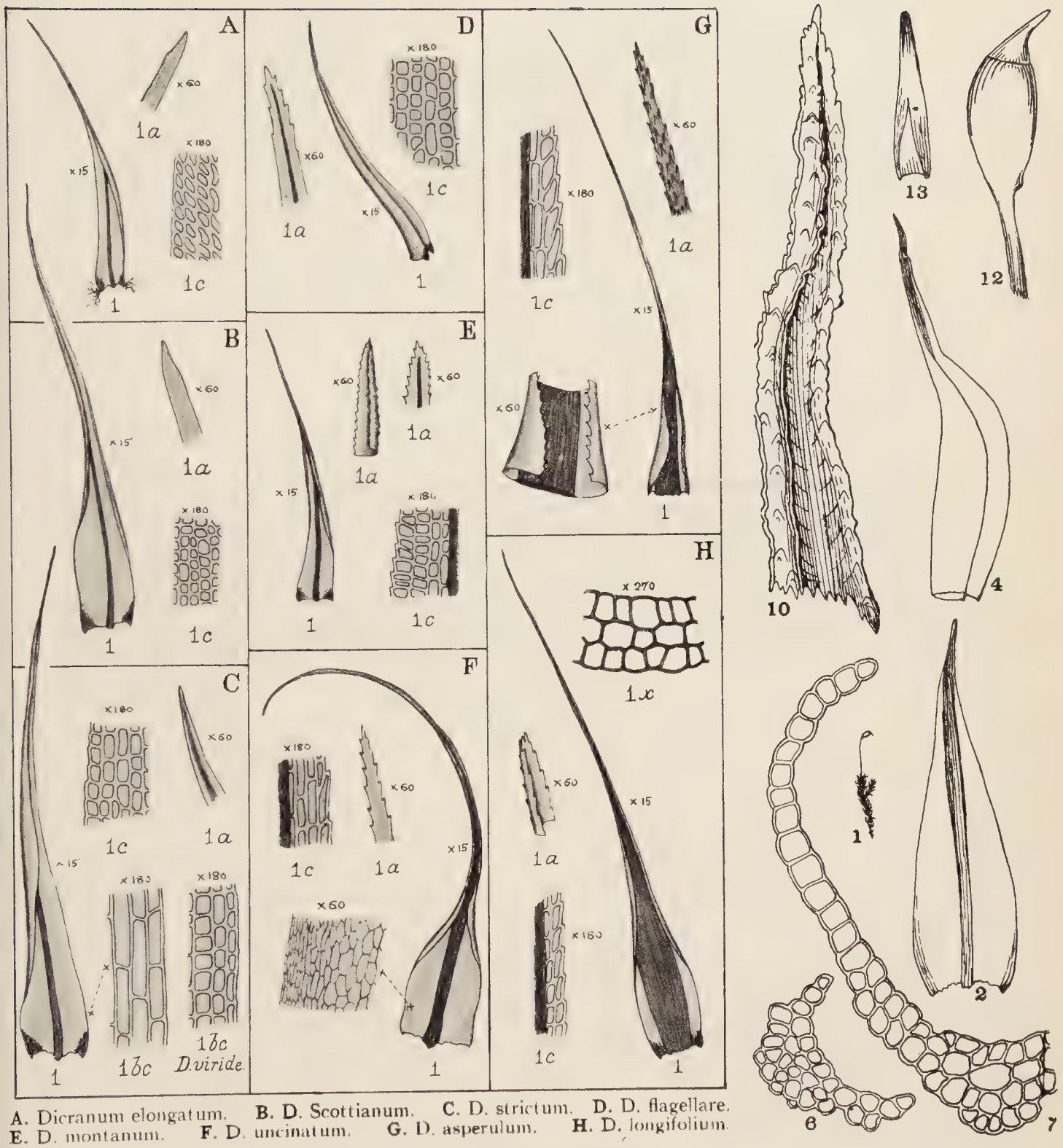
Dicran. fulvellum.



A. Campylopus introflexus. B. C. brevipilus. C. Dicranodontium longirostre.
D. Dicranum fulvellum. E. D. falcatum. F. D. schisti. G. D. Starkii.
H. D. molle. I. D. undulatum.

PLATE 44. *A–H* (at left) Dixon, Handb. Brit. Mosses pl. 15 (by permission).
Species as indicated; description under *pl. 46.*

At right, *Arctoa Blyttii* var. *hispidula* (from Bull. N. Y. Bot. Garden **2**: *pl. 34.* 1, plant, × 1; 2, leaf, × 34; 4, inner perichaetial leaf, × 34; 6, 7, cross sections of leaf, 6 × 285 and 7 × 400; 10, leaf apex × 160; 12, capsule, × 16; 13, calyptra, × 16.



A. Dicranum elongatum. B. D. Scottianum. C. D. strictum. D. D. flagellare.
E. D. montanum. F. D. uncinatum. G. D. asperulum. H. D. longifolium.

PLATE XLIV.

PLATE 45. 1–5, *Symblepharis helicophylla.* 1, plant, × 2; 2, leaves, × 25; 3, median leaf cells, × 250; 4, basal leaf cells, × 250; 5, capsule, × 17; 6–11, *Dicranoweisia Roellii.* 6, plant, × 2; 7, leaves, × 25; 8, perichaetial leaf, × 25; 9, basal cells, × 250; 10, median cells, × 250.

12–15, *Oncophorus strumulosus.* 12, plant, × 2; 13, leaves, × 25; 14, basal leaf cells, × 250; 15, upper median leaf cells, × 250.

16–22, *Arctoa hyperborea.* 16, plant enlarged; 17, leaves, × 25; 18, basal leaf cells, × 250; 19, upper leaf cells, × 250; 20, 21, capsules operculate and dry and empty; 22, cells of capsule mouth, annulus and peristome teeth. (16 and 20–22 redrawn from the Bry. Eur. *pl. 87;* all the other figures of this plate by Seville Flowers.)

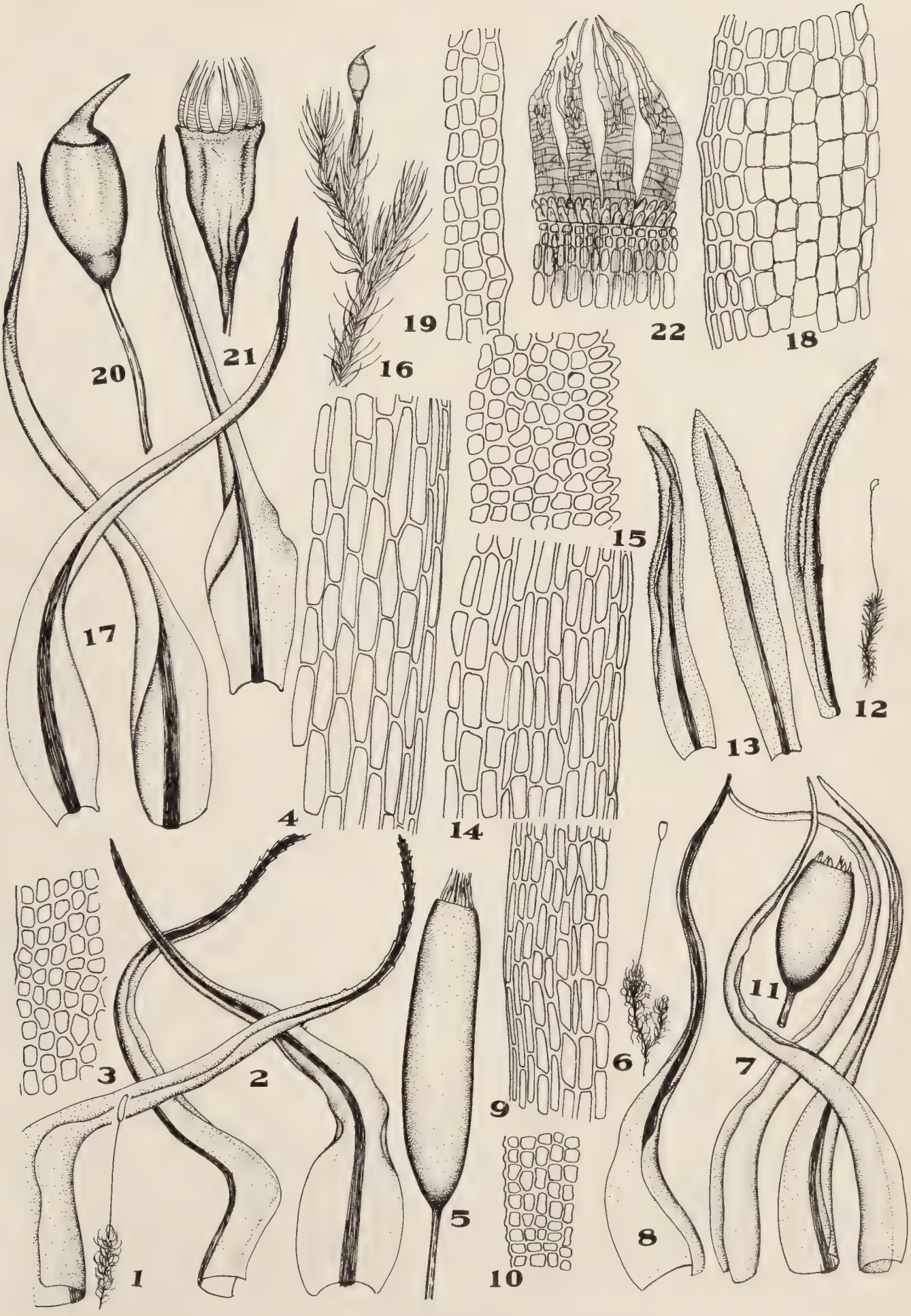


PLATE XLV.

PLATE 46. *A–F*, from Dixon, Handbk. Brit. Mosses, by permission. 1, leaf; 2, branch leaf, if different; 5, capsule; 6, peristome; *, plant or at least a portion of it; *a*, apex; *b*, base; *c*, cells at ⅓ from apex; *x*, section.

G. Dicranum rhabdocarpum from Mem. Am. Acad. 5^2: *pl. 3*. 1, plant, × 1; 6, capsule; 8, perichaetium; 9, 10, leaves; 12, leaf apex.

A. Dicranum spurium. **B.** D. Bergeri. **C.** D. scoparium. **D.** D. Bonjeani. **E.** D. fuscescens. **F.** D. maius.

PLATE XLVI.

PLATE 47. 1–7 and 12. *Dicranum spadiceum.* 1, leaves from plant from Yellowstone Park, × 20; 2, leaves from plants collected by Holzinger & Blake; 4 and 5, leaf apices of the same, × 400; 6, median leaf cells, × 400; 7, upper cells, × 266; 12, basal cells, × 400.

8–11. *Dicranum laevidens.* 8, leaves, × 20; 9, basal leaf cells, × 400; 10, median leaf cells, × 400; 11, apical cells, × 466.

13–16. *Dicranum groenlandicum.* 13, leaves, × 20; 14, basal leaf cells, × 400; 15, median leaf cells, × 400; 16, leaf apex, × 400 (the apex is typically much more obtuse).

17–20. *Dicranum fragilifolium.* 17, leaves, × 13; 18, basal leaf cells, × 233; 20, lower median leaf cells, × 233, pitted; 19, upper lamina cells, × 233. (All by Seville Flowers).

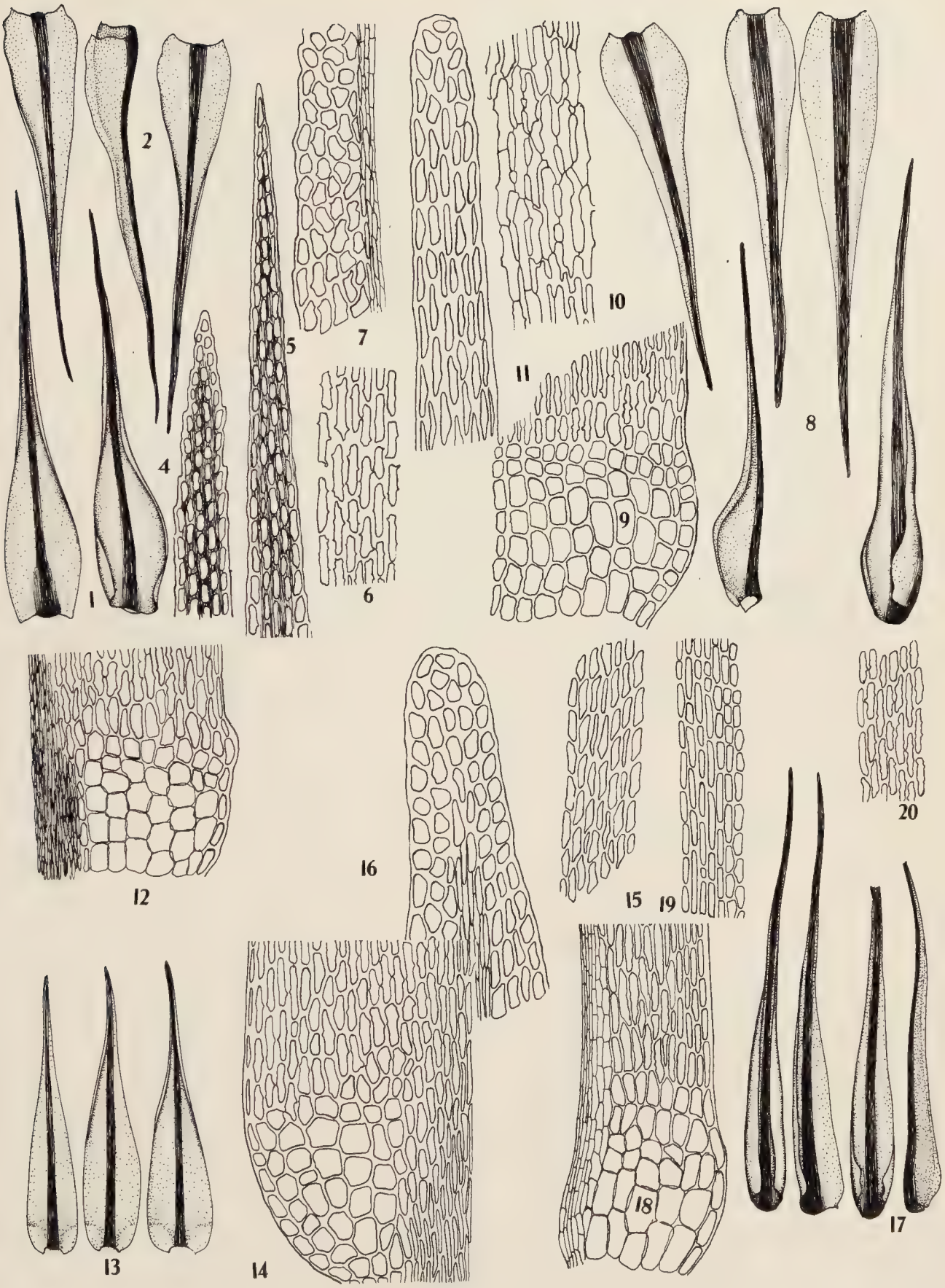
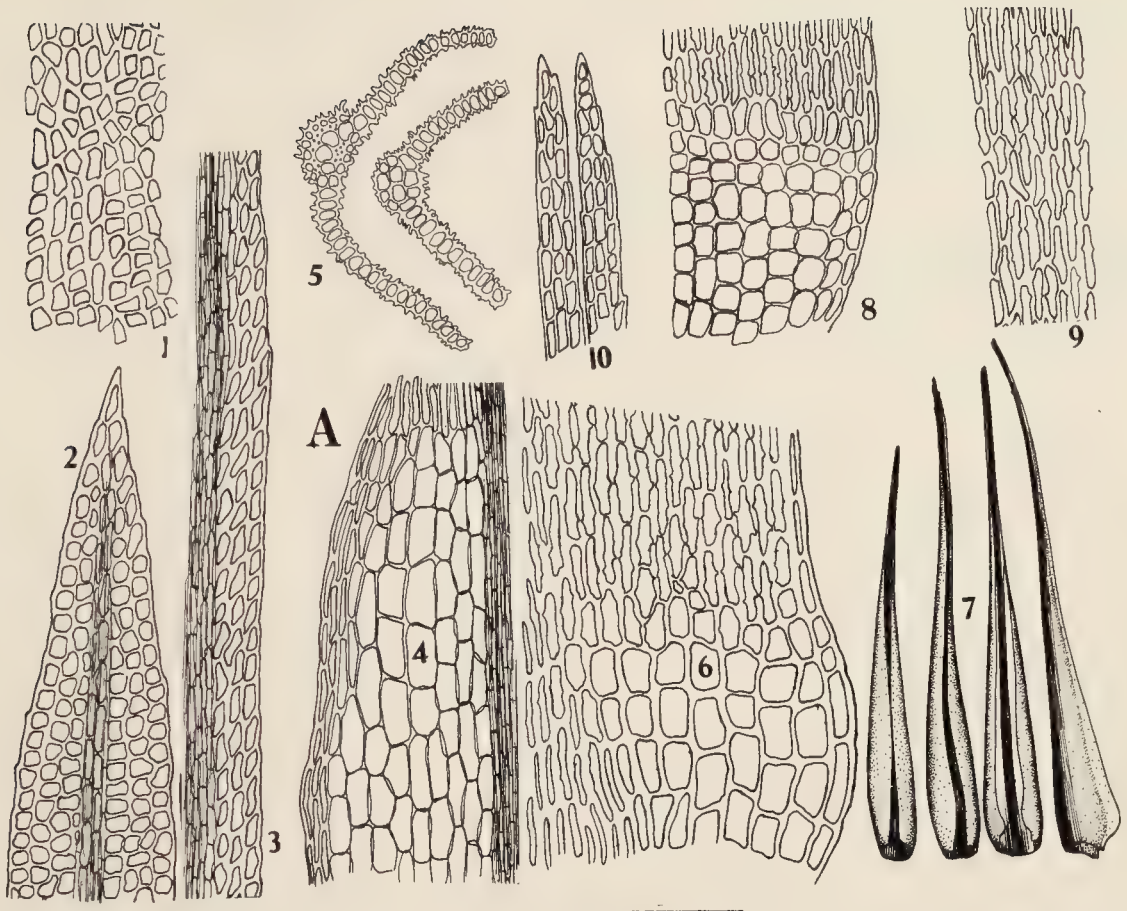
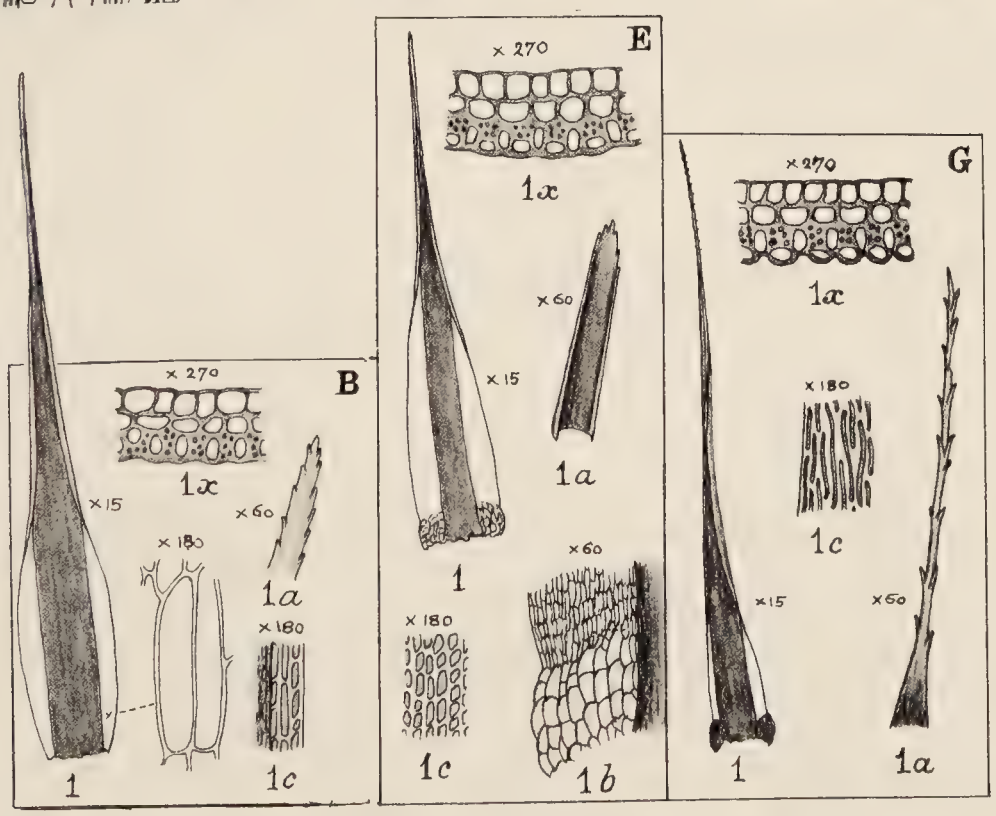


PLATE XLVII

PLATE 48. *A*. 1, upper median leaf cells of *Dicranum Drummondii*, × 400; 2, leaf apex of *Rhabdoweisia denticulata americana*, × 200; 3 median marginal cells of *Campylopus fragilis*, × 400 (R. & C. Musc. Eur. 361); 4, basal cells of the same, × 400; 5, cross sections of leaf of *Dichodontium olympicum*, × 133; 6, basal leaf cells of *Dicranum elongatum*, × 400; 7–10, *Dicranum angustum* (from Sweden); 7, leaves, × 13; 8, basal cells, × 400; 9, median leaf cells, × 400; 10, leaf apices, × 400. (By Seville Flowers).

B. *B. Campylopus fragilis; E. C. atrovirens; G. C. flexuousus*, from Dixon, Handbk. Brit. Mosses, *pl. 12* (for description see under *pl. 46*).





B. C. fragilis. E. C. flexuosus. G. C. atrovirens.

PLATE XLVIII.

PLATE 49. Figs 1–3, *Campylopus tallulensis subleucogaster*. 1, leaves, × 20; 2, basal leaf cells, × 400; 3, upper median leaf cells, × 400. (1 not numbered).

4–7, *Campylopus angustiretis*. 4, leaves, × 20; 5, basal leaf cells, × 400; 6, median leaf cells, × 400; 7, leaf apex, × 400.

8–18, *Campylopus gracilicaulis*. 8, plants, × ⅔ (often more tufted at the top than shown); 9, stem leaves of the type; 10, comal leaves of a Florida plant; 11, 12, 13, basal, median and upper median leaf cells respectively, × 400; 14, leaf apex, × 400; 15, fruiting plant, × 3; 16, seta and capsule, × 20; 17, calyptra, × 13; 18, peristome, × 200 (By Seville Flowers).

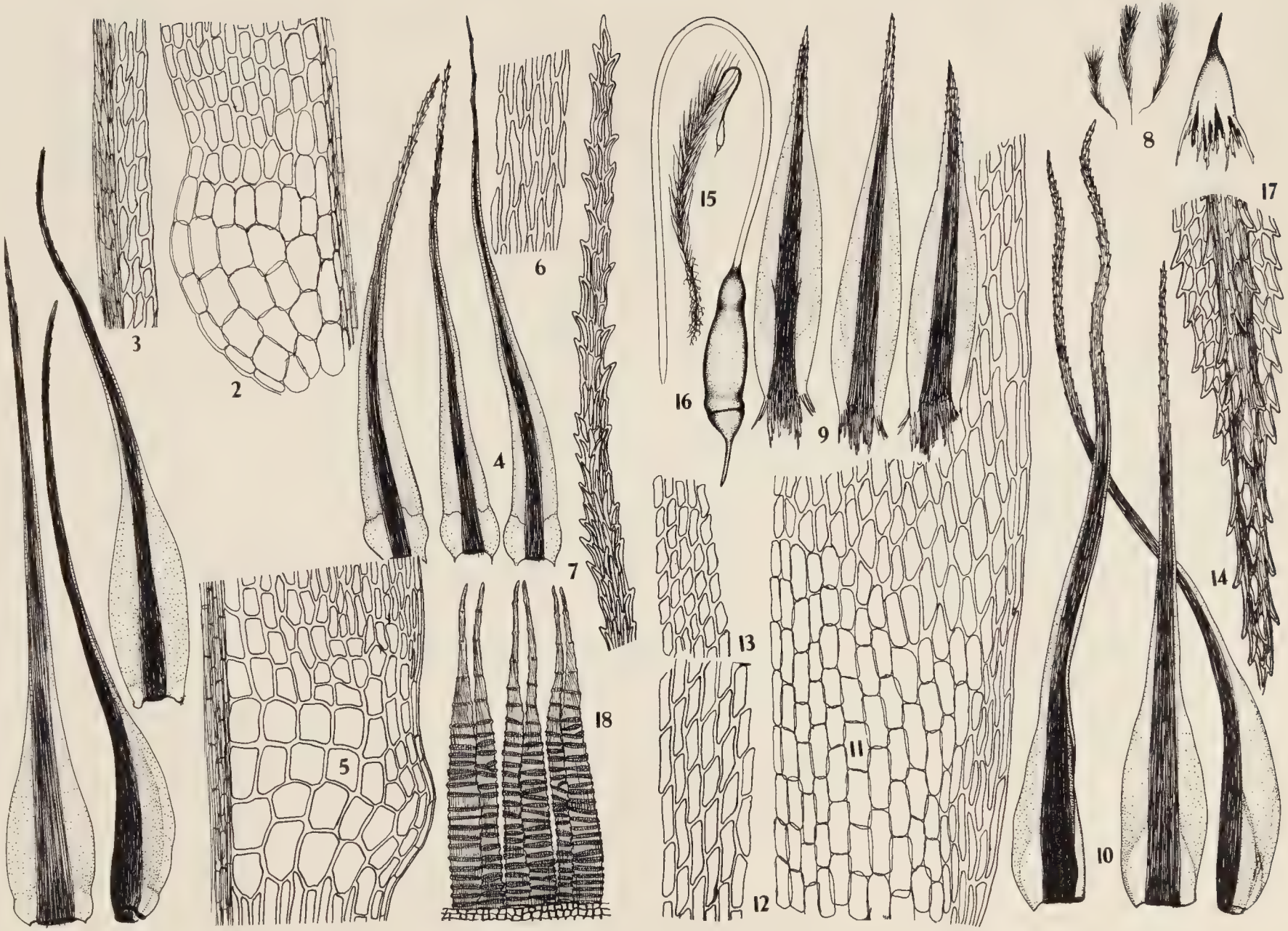


PLATE XLIX.

PLATE 50. *A. Campylopus tallulensis* (from Sull. Icones *pl. 17*). 1, plants, × 1; 2, enlarged; 3, 4, leaves; 6–9, cross sections of leaf from near apex to base; 5, areolation of leaf base; 10, of leaf apex.

B. Brothera leana (from Sull. Icones Musc. *pl. 18*). 1, plants natural size; 2, 3, the same much enlarged; 4, 5, 6, leaves; 7 and 8, cells of leaf apex and base respectively; 9, cross sections of leaf; 10, 11, branched upper stem showing attachment of rudimentary leaves which probably act as brood bodies; 12, these last enlarged still more.

C. Dicranum Drummondii (from Sull. Icones Musc. Suppl. *pl. 33*). 1, plants, × 1, both wet and dry; 2, leaves; 3, cell structure of leaf apex; 6, operculate capsule.

PLATE L.

PLATE 51. *A. Paraleucobryum Sauteri* (from Bry. Eur. *pl. 71*). 4, 5, leaves; 5*a*, 5*b*, areolation of leaf apex and base; 6, male bud; 8, 9, inner perigonial leaves; 11, perichaetium; 16, dry and empty capsule; 17, 18, 19, peristome teeth.

B. Paraleucobryum enerve (from Bry. Eur. *pl. 73*). 6, leaves; 4*a*, 4*b*, leaf apex and base showing structure; 8, branch with abortive perichaetia; 9–12, leaves of the same; 13, perichaetium; 23, annulus; 24, portion of mouth of capsule with peristome teeth.

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PLATE LI.

PLATE 52. 1–5, *Octoblepharum albidum.* 1, plant, × 2; 2, leaves, × 25; 3, cross section of leaf, × 125; 4, capsules, × 17; 5, peristome teeth, × 250.

6–11, *Leucobryum albidum.* 6, moist plants, × 2; 7, dry plant, × 2; 8, leaves, × 25; 9, cross sections of leaf, × 125; 10, capsules, × 17; 11, peristome tooth, × 125.

12–14, *Leucobryum glaucum.* 12, dry plant, × 4; 13, leaves, × 25; 14, partial section of leaf near base, × 125. (Magnification of 14 doubtful.)

15–18, *Leucobryum antillarum.* 15, small plant dry, × 2; 16, leaves, × 25; 17, cross sections of leaf, × 125. (All drawings by Seville Flowers.)

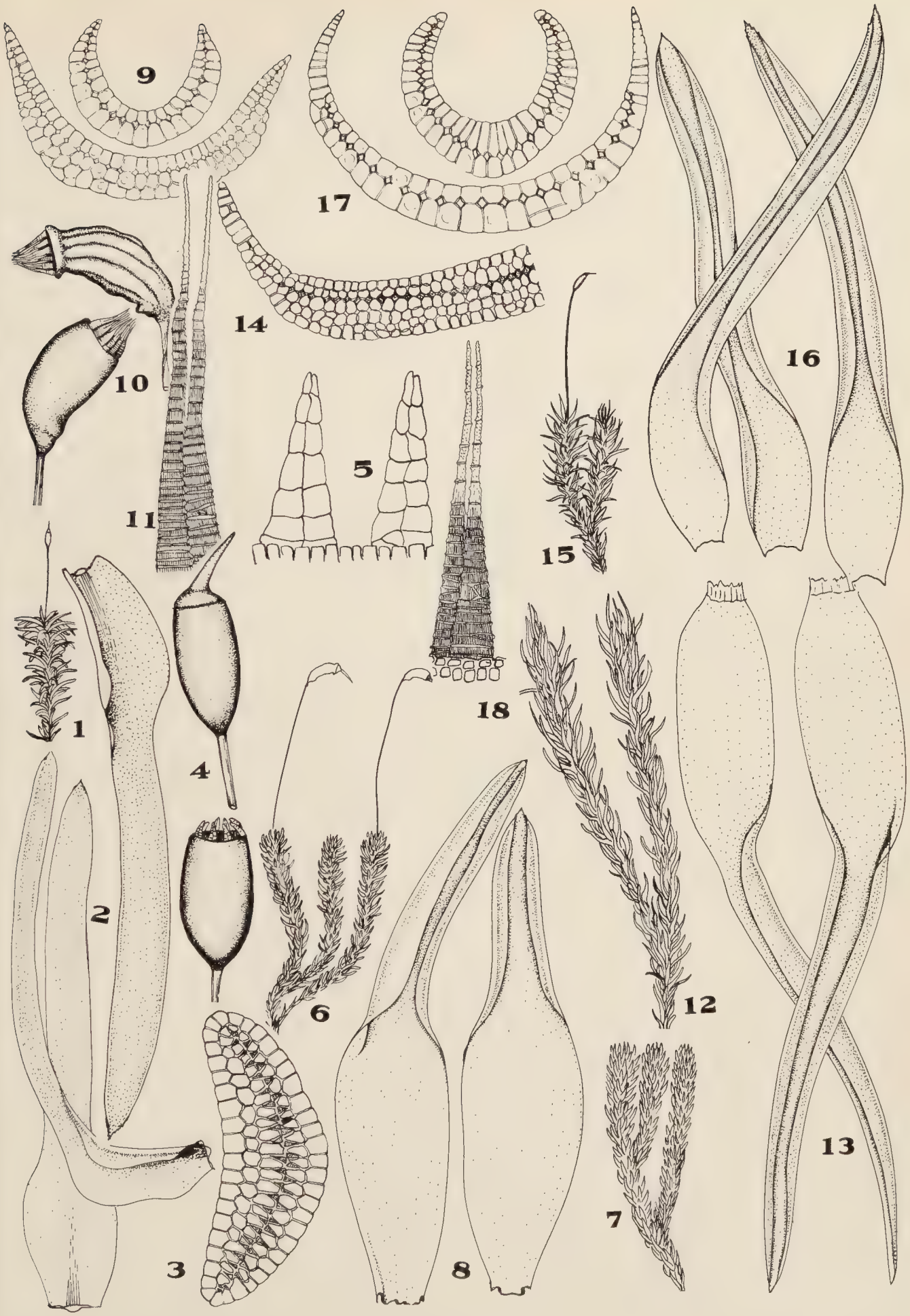
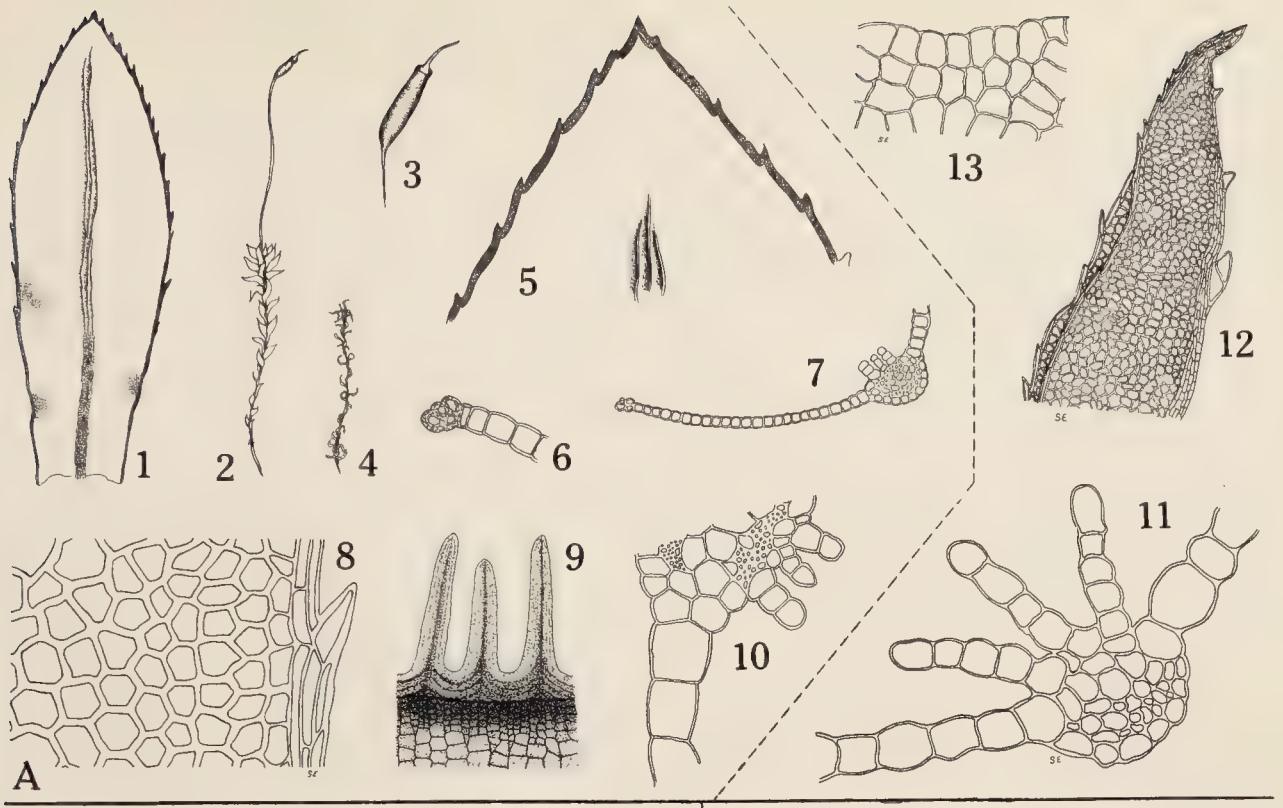


PLATE LII.

PLATE 53. *A. Atrichum crispum* (1–7, 9–10 from Proc. Wash. Acad. Sci. **12**: 277. *f. 1.*). 1, leaf, × 11; 2, moist plant with capsule, × 1; 3, capsule with lid, × 4; 4, plant dry, showing crisping of leaves, × 1; 5, leaf tip, × 49; 6, cross section of leaf margin showing thickened border cells, × 208; 7, cross section of leaf showing lamellae, × 49; 8, marginal cells about ⅔ up leaf, × 144; 9, peristome, × 103; 10, cross section of a few lamellae, × 208; 11, cross section of a few lamellae of var. *molle*, × 250; 12, leaf tip of var. *molle* twisted to show marginal cells of leaf and teeth on back of costa, × 57; 13, cells of lamella of var. *molle*, × 250.

B. Atrichum undulatum (14–16 after Jennings; 2, 4–8, 10–12, from Proc. Wash. Acad. Sci. **12**: 279 *f. 3;* 9, 18–19 from Proc. Wash. Acad. Sci. **12**: 280. *f. 4* as *Catharinea Selwyni*). 1, cells of lamella, × 250; 2, leaf tip, × 49; 3, marginal cells about ⅔ up leaf, × 250; 4, cross section of leaf, × 49: 5, cross section of a few lamellae, × 208; 6, cross section of leaf margin showing thickened border cells, × 208; 7, moist plant with capsule, × 1; 8, capsule with lid, × 3.5; 9, capsule shownig peristome, × 3.5; 10, dry antheridial plant with (*d*) antheridial disk through which stem has continued, × 1; 11, leaf, × 14; 12, peristome, × 117; 13, moist plant with capsules of var. *Haussknechtii*, × 1; 14, plant with capsule of var. *minor*, × 1; 15, leaf of var. *minor*, × 5; 16, cross section of leaf of var. *minor*, × 75; 17, cells of lamella of var. *minor*, × 150; 18, cross section of leaf of var. *Selwyni*, × 49; 19, cross section of a few lamellae of var. *Selwyni*, × 183.



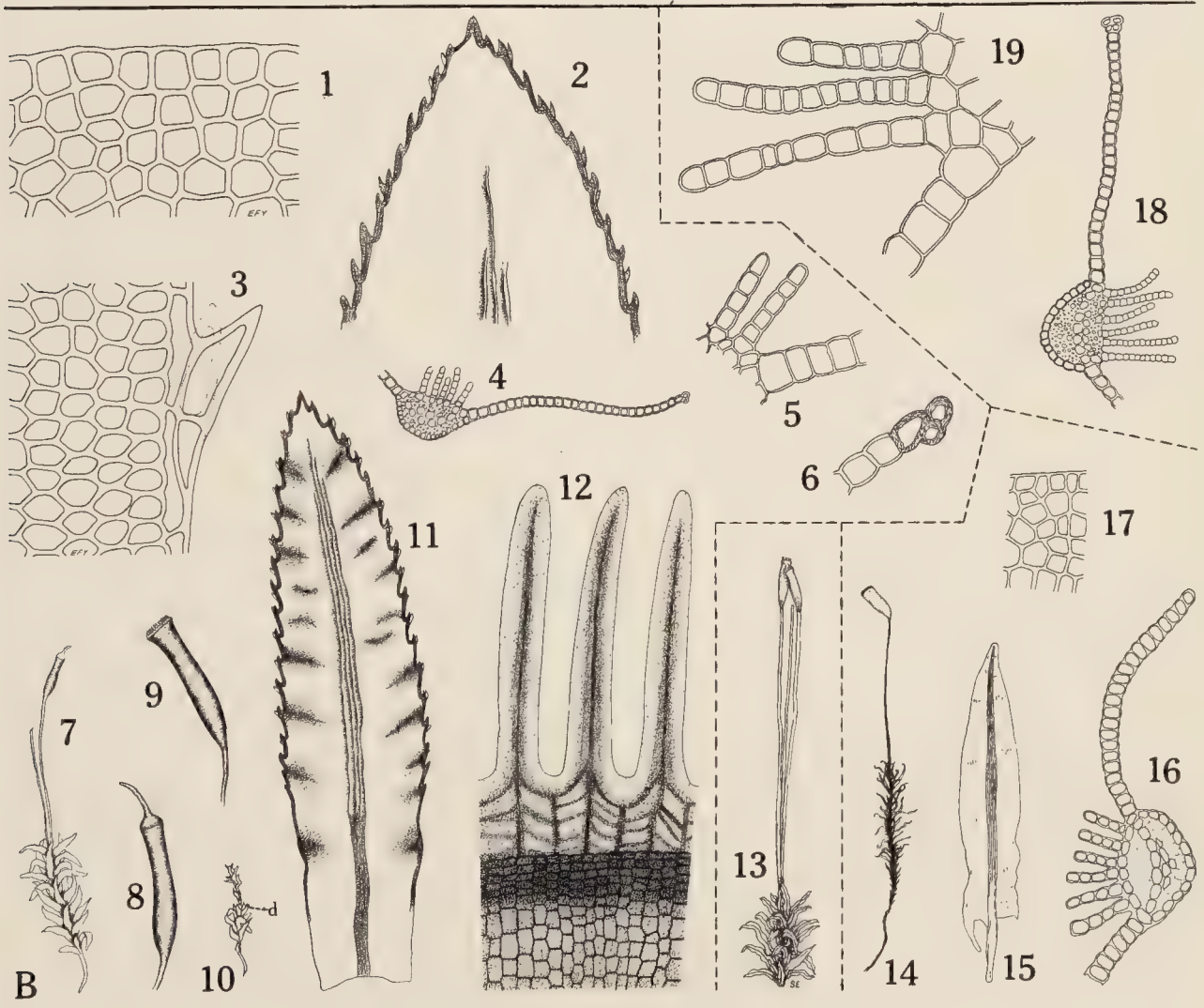


PLATE LIII.

PLATE 54. *A. Atrichum angustatum* (8, 19 from Proc. Wash. Acad. Sci. **12**: 278. *f. 2;* 22–24 after Jennings). 1. capsule showing peristome, × 7; 2, capsule and bract, × 2; 3, moist plant, × 0.67; 4, dry plant, × 3.3; 5, calyptra, × 29; 6, hair of the calyptra, × 655; 7, lid of capsule, × 35; 8, capsule with lid, × 4; 9, cells of lamella, × 250; 10, marginal cells of the leaf, × 250; 11, leaf tip from back, × 150; 12, teeth of the peristome, × 218; 13, leaf of female branch, back view, × 4; 14, leaf of female branch, front view, × 4; 15, basal marginal cells of leaf, × 147; 16, cross section of leaf, × 108; 17, inner perichaetial leaf, front view, × 12; 18, leaf cells about ¾ of the way between costa and border, × 132; 19, cross section of a few lamellae, × 167; 20, cross section of leaf margin showing thickened border cells, × 193.3; 21, cross section of leaf, × 43.3; 22, leaf of var. *plurilamellatum*, × 8; 23, cross section of leaf of var. *plurilamellatum*, × 80; 24, moist plant of var. *plurilamellatum* with capsule, × 1.

B. Atrichum papillosum (1–3, 5 after Jennings). 1, moist plant with capsule, × 1; 2, leaf, × 10; 3, teeth of peristome, × 55; 4, capsule showing peristome, × 4; 5, lower marginal cells of the leaf, × 267; 6, cross section of leaf showing a few lamellae, × 307.

C. Atrichum Macmillani (4–8 from Rhodora **9**: *pl. 74*). 1, moist plant with capsule, × 2.3; 2, dry plant, × 1.7; 3, leaf, × 8; 4, outline of median cross section of leaf, × 50; 5, detail of same cross section, × 150; 6, basal marginal cells of median leaf, × 150; 7, upper marginal cells of median leaf, × 150; 8, teeth of peristome, × 198.

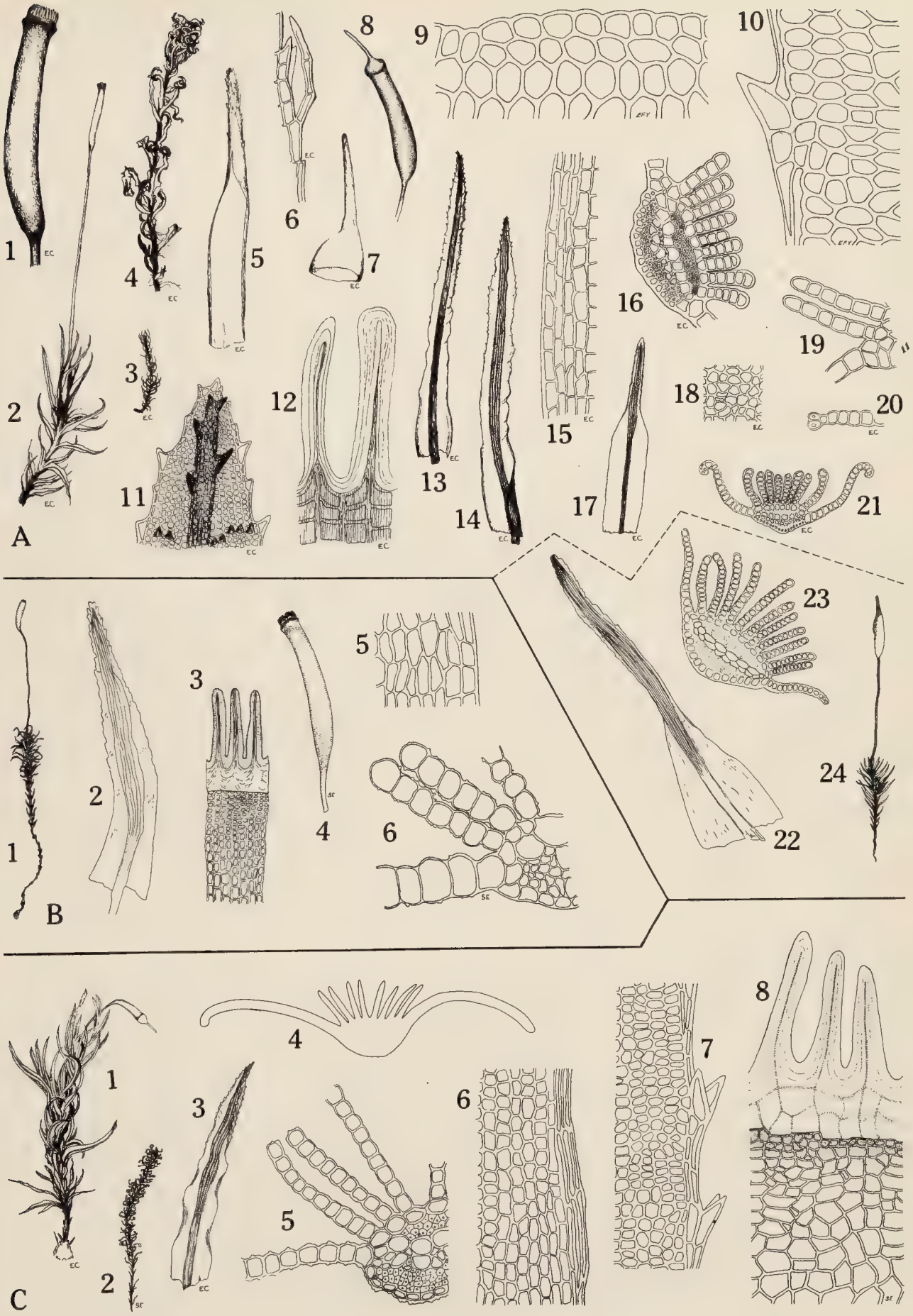

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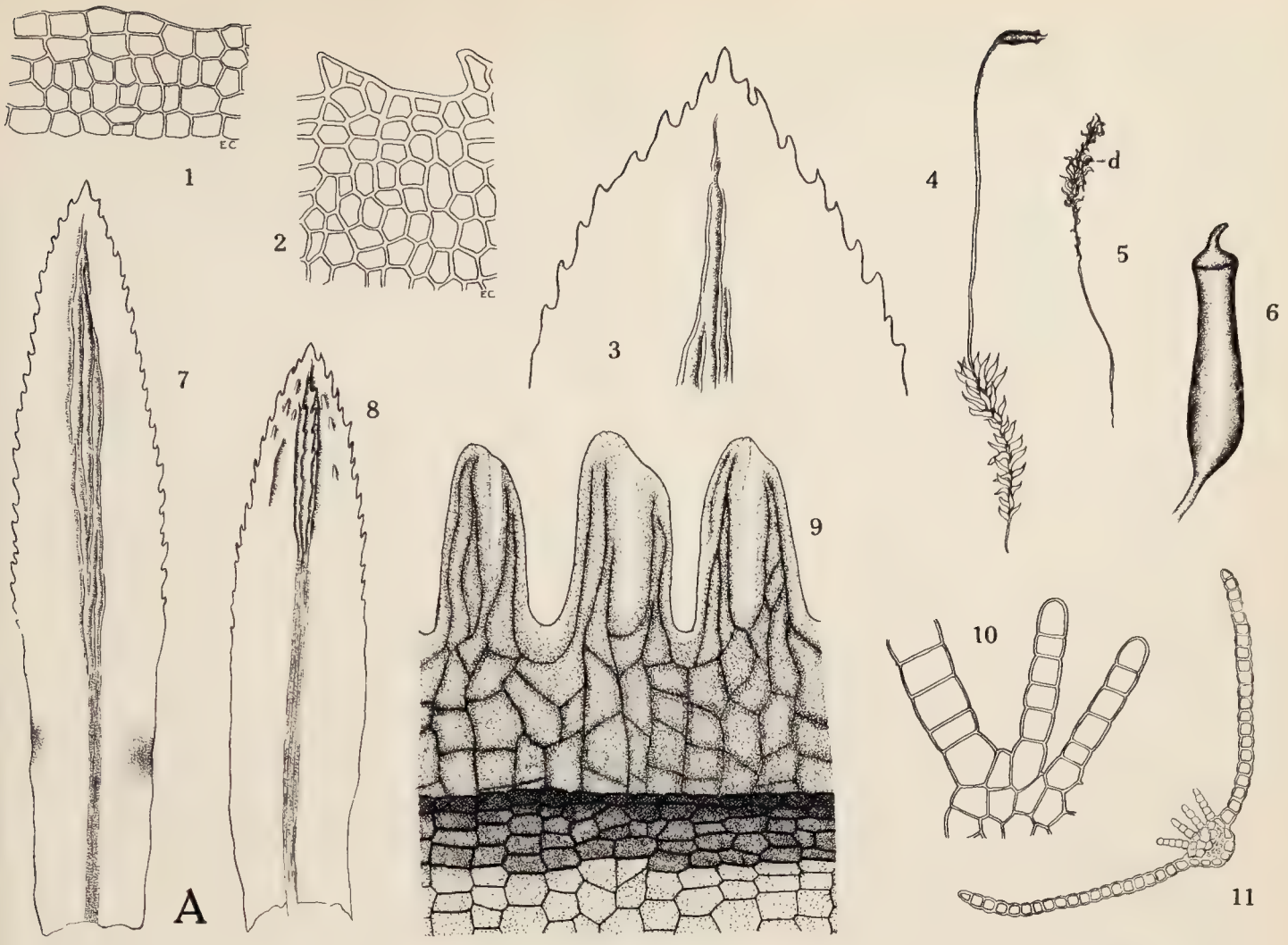
PLATE LIV.

PLATE 55. *A. Oligotrichum parallelum* (3–11 from Proc. Wash. Acad. Sci. **12:** 283. *f. 5*). 1, side view of lamella, the upper edge the margin, × 184; 2, leaf cells at about ¾ up, × 184; 3, ventral view of leaf tip, × 58; 4, moist plant, × 0.9; 5, dry plant, *d*, the location of the antheridial cup, × 0.9; 6, capsule, × 4.5; 7, ventral view of leaf, × 13.5; 8, dorsal view of leaf, × 13.5; 9, peristome, × 135; 10, cross section of a few lamellae, × 225; 11, cross section of leaf at about ⅔ up, × 58.

B. Oligotrichum hercynicum (1, 3–9, 11, 13–15 from Proc. Wash. Acad. Sci. **12:** 285. *f. 7* as *O. incurvum;* 10, 12 from Bryol. Eur. *pl. 413*). 1, plant dry, × 0.9; 2, side view of ventral lamella, × 184; 3, dorsal view of leaf almost entire, × 13.5; 4, ventral view of leaf with dorsal lamellae and crests on lamina, × 13.5; 5, cross section of a few lamellae, × 225; 6, ventral view of leaf with entire margins, × 13.5; 7, leaf tip, entire, with distinct dorsal lamellae, × 58; 8, leaf tip, serrate, with low dorsal lamellae, × 58; 9, plant moist, × 0.9; 10, calyptra, × 9.6; 11, capsule, × 4.5; 12, lid, × 12; 13, cross section of leaf about ⅔ up, × 58; 14, peristome, × 135; 15, marginal leaf cells at ¾, × 450.



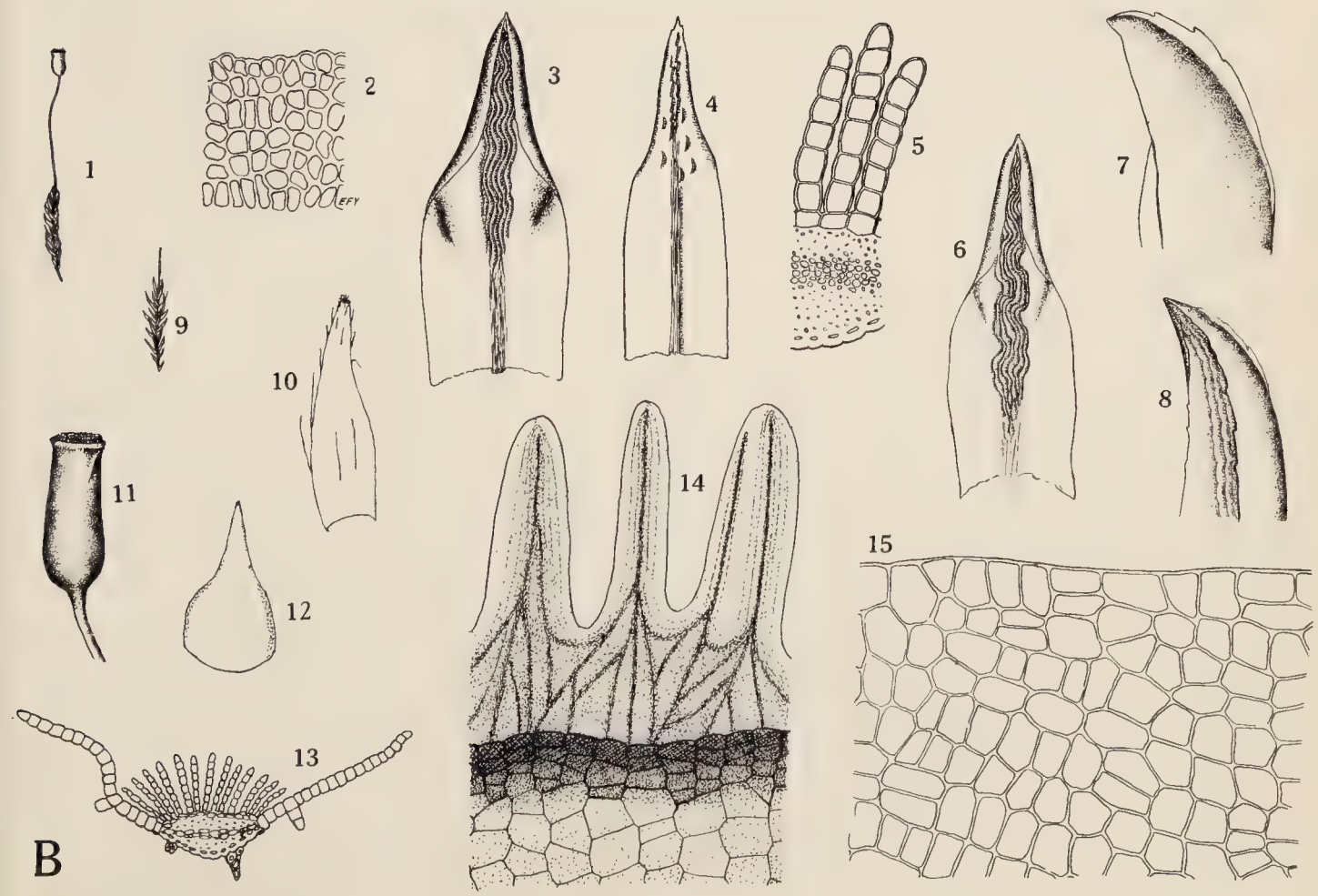


PLATE LV.

PLATE 56. *A. Oligotrichum aligerum* (3–9 from Proc. Wash. Acad. Sci. **12**: 284. *f. 6*). 1, leaf margin at about ¾ up, × 400; 2, side view of lamella, the upper edge the margin, × 400; 3, moist plant, about × 1; 4, leafy part of moist plant, *d*, antheridial bracts, about × 1; 5, hair of calyptra; 6, capsule, about × 100; 7, calyptra; 8, cross section of leaf at about ¾ up, *m*, leaf margin, about × 25; 9, peristome, about × 140; 10, leaf tip, × 50; 11, ventral view of leaf, × 28.

B. Oligotrichum laevigatum (4–9, 11 from Proc. Wash. Acad. Sci. **12**: 289. *f. 9* as *Psilopilum glabratum;* 12–14 from Proc. Wash. Acad. Sci. **12**: 287. *f. 8a* as *Oligotrichum incurvum* var. *latifolium*). 1, side view of lamella, the upper edge the margin, × 230; 2, margin of leaf at about ⅔ up showing characteristic diagonal walls, × 400; 3, leaf tip, ventral view, × 91; 4, ventral side of leaf, × 17; 5, moist plant, × 1.1; 6, dry plant, × 1.1; 7, cross section of a few lamellae, × 281; 8, peristome, × 169; 9, mature capsule, × 5.6; 10, calyptra, × 12.5; 11, cross section of leaf, × 74; 12, ventral view of leaf of var. *cavifolium*, × 7.5; 13, side view of leaf tip of var. *cavifolium*, × 32.5; 14, cells of leaf margin of var. *cavifolium* at about ¾ up, × 250.

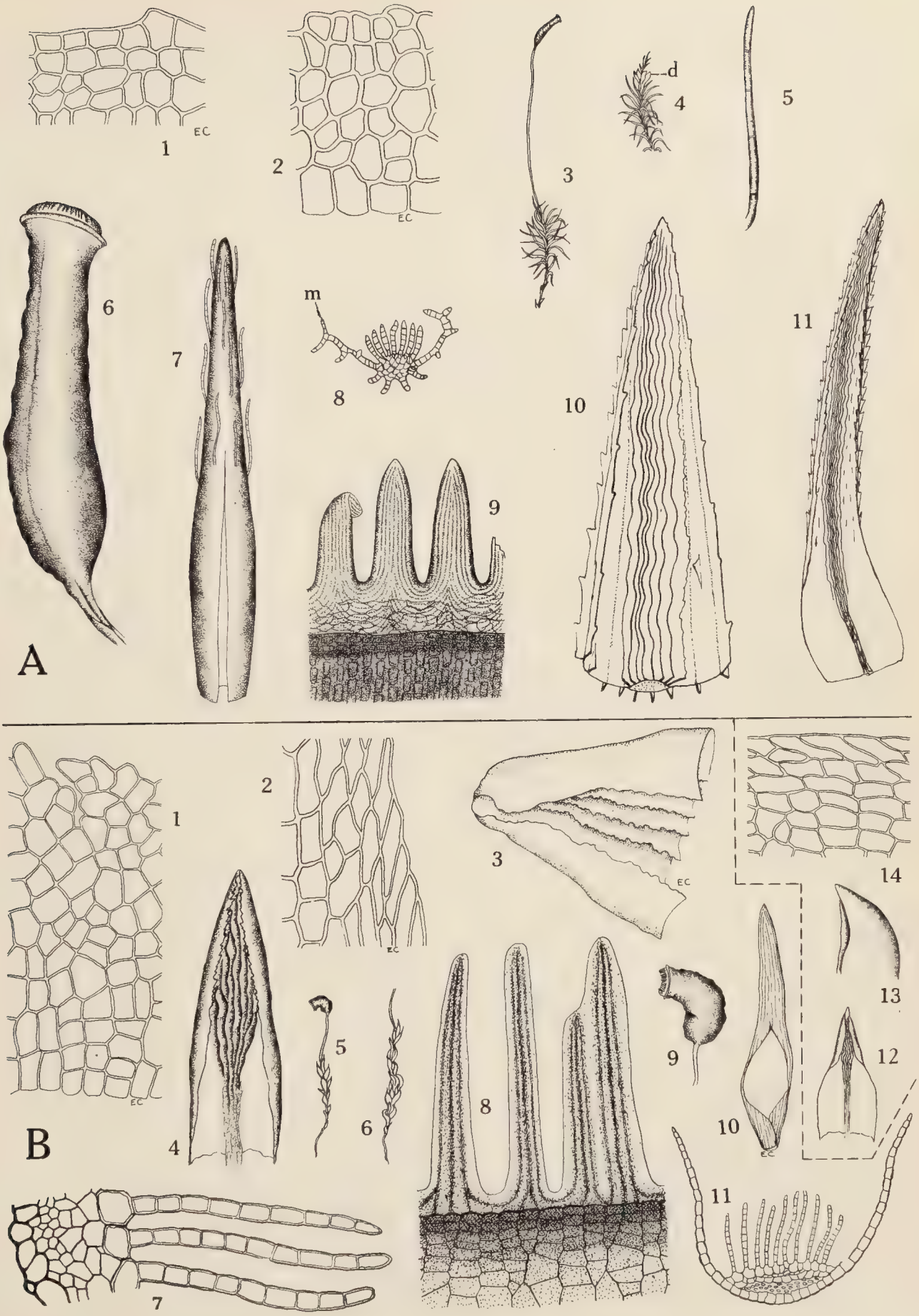
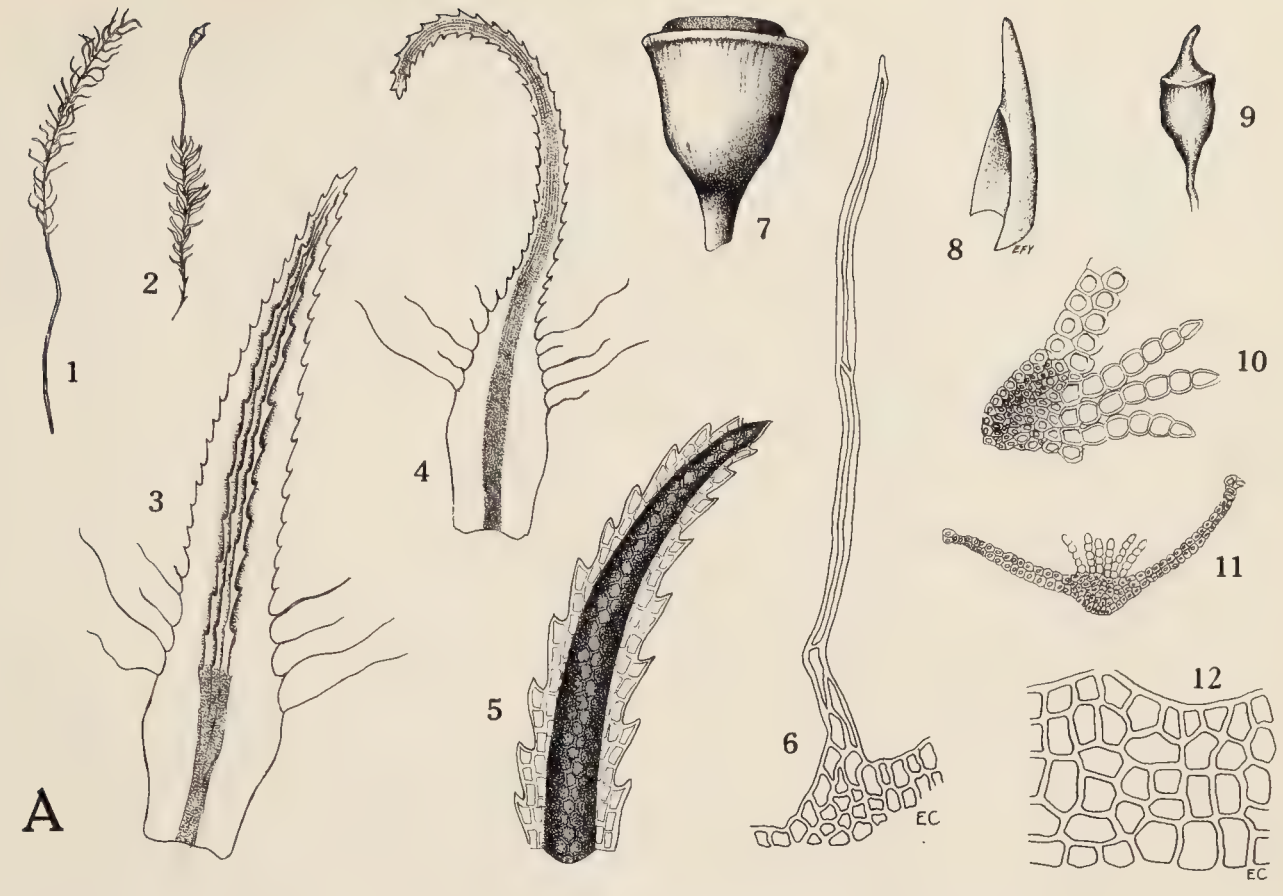


PLATE LVI.

PLATE 57. *A. Lyellia Lescurii* (1–5, 7, 9–11 from Proc. Wash. Acad. Sci. **12**: 291. *f. 10* as *Bartramiopsis Lescurii*). 1, dry plant, × 1; 2, moist plant with capsule, × 1; 3, leaf, upper side, × 18; 4, back of leaf, × 13.5; 5, leaf tip, × 125; 6, marginal cilium of leaf, × 230; 7, mature capsule, × 10; 8, calyptra, about × 10; 9, capsule dried and rather young, showing lid, × 6.2; 10, cross section of a few lamellae, × 312; 11, cross section of leaf, × 81; 12, side view of lamella, the upper edge the margin, × 400.

B. Lyellia aspera (from Medd. om Groenland **15**: 390. *f. 1–9*, as *Philocrya aspera*). 1, leaf, upper side, × 10; 2, leaf tip seen from side, × 55; *c*, leaf tip, × 30; 4, cross section of margin of leaf at about ⅓ up, × 260; 5, cross section of leaf near tip, × 55; 6, side view of lamella, the upper edge the margin, × 260; 7, median cross section of leaf, × 30; 8, cross section showing the lamellae, × 130; 9, median cross section of the leaf margin, × 260.



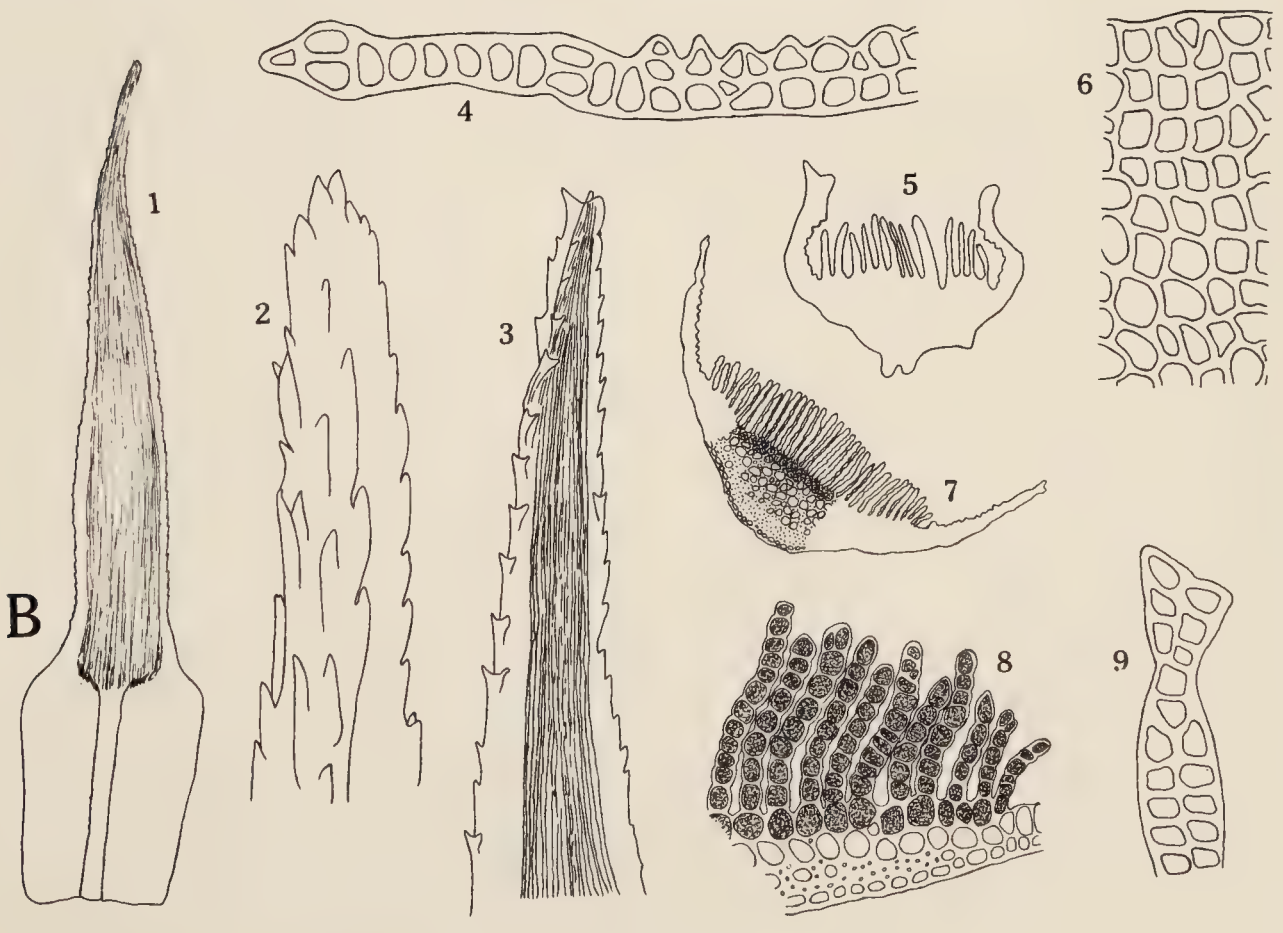
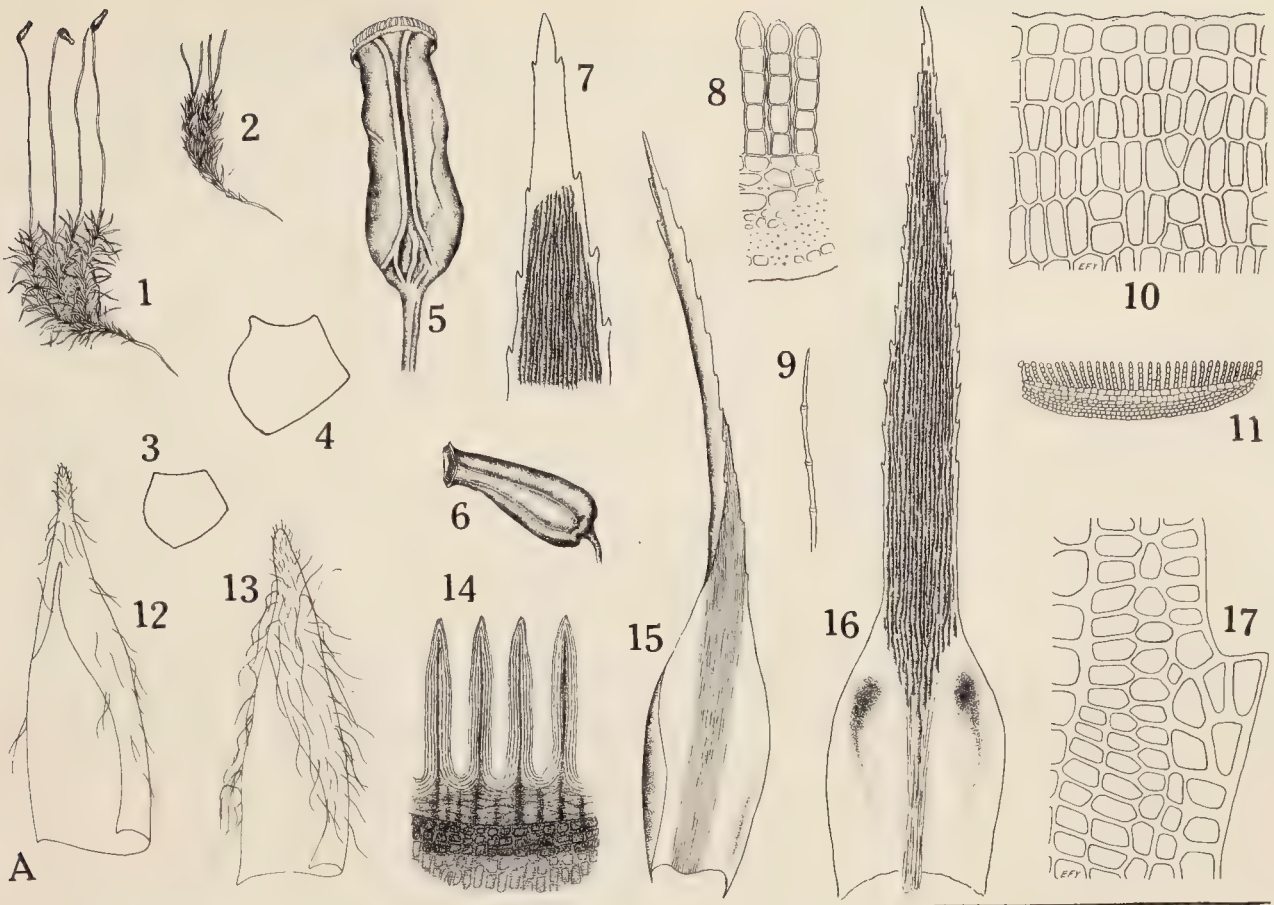


PLATE LVII.

PLATE 58. *A. Polytrichadelphus Lyallii* (1–9, 11, 14–16 from Proc. Wash. Acad. Sci. **12:** 293. *f. 11;* 12–13 from Bryol. **35:** *pl. 4*). 1, moist plant with capsules, × 0.8; 2, dry plant, × 0.8; 3, cross section of capsule near mouth, × 7; 4, cross section of capsule near base, × 7; 5, capsule, showing double fold; 6, capsule, × 4; 7, leaf tip, × 45; 8, cross section of a few lamellae, × 180; 9, hair of calyptra; 10, side view of lamella, × 250; 11, cross section of leaf, × 33; 12, calyptra with few hairs, × 8; 13, calyptra, quite hairy, × 8; 14, peristome, about × 75; 15, 16, leaves, × 12; 17, marginal cells about ⅔ up leaf, × 250.

B. Pogonatum pensilvanicum (1, 3, 6, 8 after Jennings). 1, central margin of leaf, × 267; 2, side view of lamella, × 250; 3, lower margin of leaf, × 267; 4, moist plant with capsule, × 3; 5, upper margin of leaf, × 250; 6, leaf, × 12; 7, capsule with lid, × 10; 8, peristome, about × 67.

C. Pogonatum brachyphyllum. 1, moist plant with capsule, × 3.3; 2, moist plant, × 2; 3, calyptra, × 8; 4, side view of lamella, × 250; 5, capsule with lid, × 8; 6, papillosity of epidermis of capsule, × 67; 7, capsule, × 4; 8, margin of leaf at about ¾ up, × 267; 9, leaf, × 8; 10, leaf from nearer base of plant, × 8; 11, cross section of margin of leaf, × 267; 12, peristome, × 61; 13, cross section of leaf, × 61.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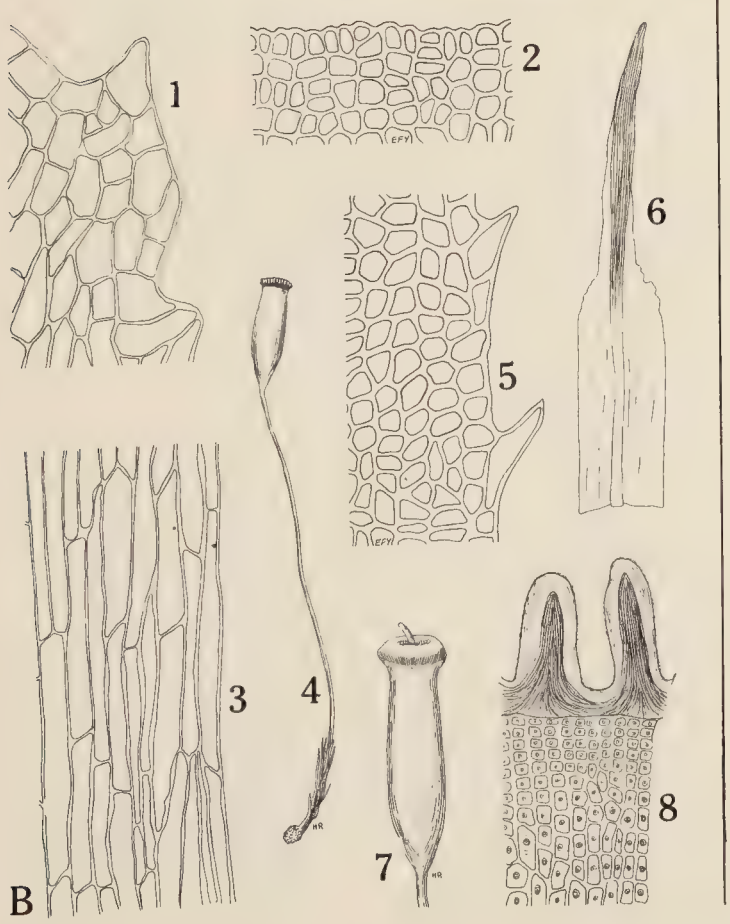
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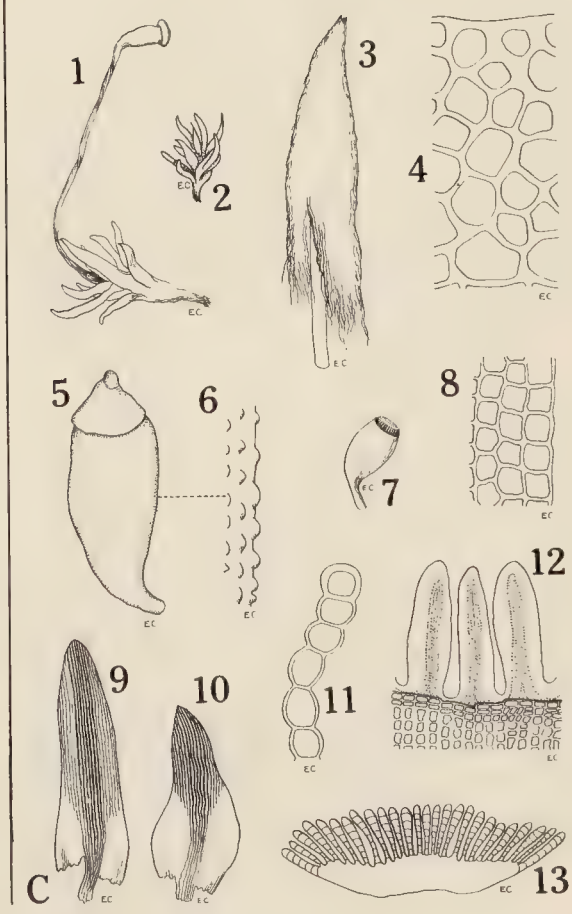
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PLATE LVIII.

PLATE 59. *A. Pogonatum contortum* (1–5, 7–10, 12–13 from Proc. Wash. Acad. Sci. **12**: 296. *f. 12*). 1, moist plant with capsule, stem having continued beyond point where pedicel arises, × 1; 2, dry antheridial plant, *d*, antheridial disk through which stems have grown, × 1; 3, 4, capsules, × 4; 5, immature capsule covered by calyptra, × 4; 6, side view of lamella, the upper edge the margin, × 250; 7, leaf tip, × 45; 8, cross section of leaf margin, × 167; 9, cross section of leaf, × 45; 10, cross section of a few lamellae, × 167; 11, marginal cells of leaf at about ⅔ up, × 250; 12, peristome, × 117; 13, leaf, showing lamellae on upper side, × 12.

B. Pogonatum urnigerum (2, 4–11 from Proc. Wash. Acad. Sci. **12**: 300. *f. 14*). 1, marginal cells of leaf at about ⅔ up, × 250; 2, leaf tip, × 49; 3, side view of lamella, showing marginal papillosity, × 250; 4, cross section of leaf, × 49; 5, cross section of a few lamellae, showing rounded, thick walled papillose marginal cells, × 171; 6, peristome, × 93; 7, capsule with lid, × 4; 8, immature capsule covered by calyptra, × 0.8; 9, dry antheridial plant, *d*, old antheridial disk through which young shoot has grown, × 0.8; 10, moist plant with capsule, × 0.8; 11, leaf, showing lamellae on upper side, × 12.

C. Pogonatum capillare (1, 4–18 from Proc. Wash. Acad. Sci. **12**: 298. *f. 13*). 1, moist plant with capsules, × 0.7; 2, marginal cells of leaf at about ⅔ up, × 250; 3, moist plant with capsule, × 0.7; 4, 5, dry antheridial plants, *d*, antheridial disks, × 0.7; 6, side view of lamella, showing marginal papillosity, × 250; 7, cross section of a few lamellae, × 180; 8, 9, cross sections of leaves, × 45; 10, 11, capsules with lid, × 4; 12, 13, immature capsules covered by calyptras, × 4; 14, leaf tip, × 45; 15, leaf, × 11; 16, peristome, × 105; 17, double tooth of peristome, × 105; 18, leaf, × 11.

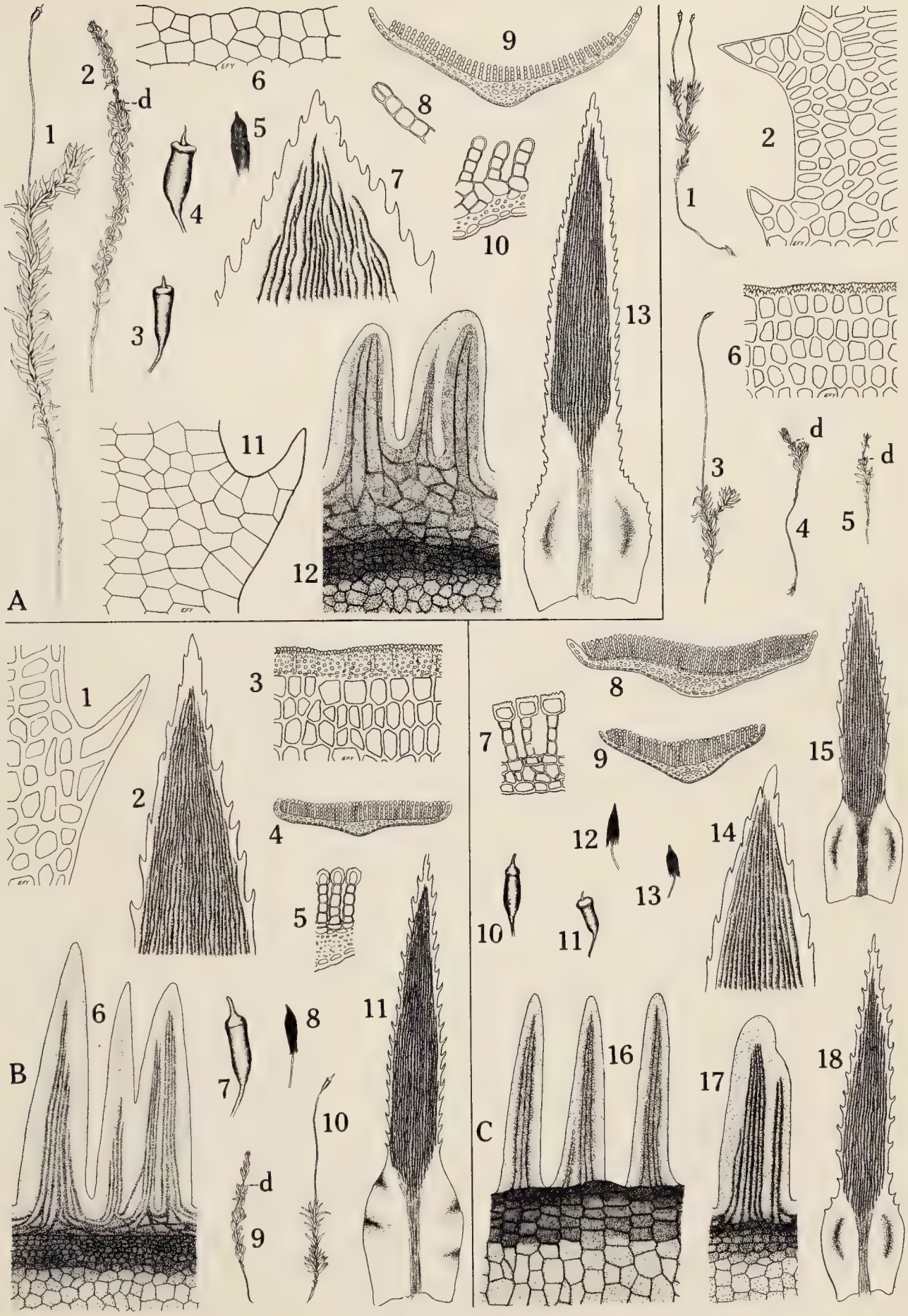


PLATE LIX.

PLATE 60. *Pogonatum alpinum* (1–4, 6–9, from Proc. Wash. Acad. Sci. **12**: 302. *f. 15*). 1, leaf, × 12; 2, leaf tip, × 45; 3, dry plant, × 0.7; 4, moist plant, × 0.7; 5, marginal cells about ⅔ up leaf, × 250; 6, cross section of a few lamellae showing thickened and papillose marginal cells, × 180; 7, cross section of leaf, × 45; 8, peristome, × 110; 9, capsule, × 3.5; 10, side view of lamella, × 267; 11, side view of margin of lamella, × 800.

12–14. *Pogonatum alpinum* var. *Macounii* (13–14 from Proc. Wash. Acad. Sci. **12**: 305. *f. 16* in part). 12, dry plant, × 1; 13, leaf, × 12; 14, capsule, × 4.

15–18. *Pogonatum alpinum* var. *arcticum* (15–18 from Proc. Wash. Acad. Sci. **12**: 306. *f. 17* in part). 15, leaf, × 12, 16, dry plant with capsule, × 0.7; 17, capsule, × 3.5; 18, moist plant, × 0.7.

19–22. *Pogonatum alpinum* var. *septentrionale* (19–21 from Proc. Wash. Acad. Sci. **12**: 306. *f. 17* in part). 19, leaf, × 12; 20, dry plant, × 0.7; 21, capsule, × 3.5; 22, marginal cells about ⅔ up leaf, × 250.

23–28. *Pogonatum alpinum* var. *brevifolium* (23–28 from Proc. Wash. Acad. Sci. **12**: 306. *f. 17* in part as var. *simplex*). 23, 24, leaves, × 12; 25, 26, capsules, × 3.5; 27, moist plant, × 0.7; 28, dry plant with capsules, × 0.7.

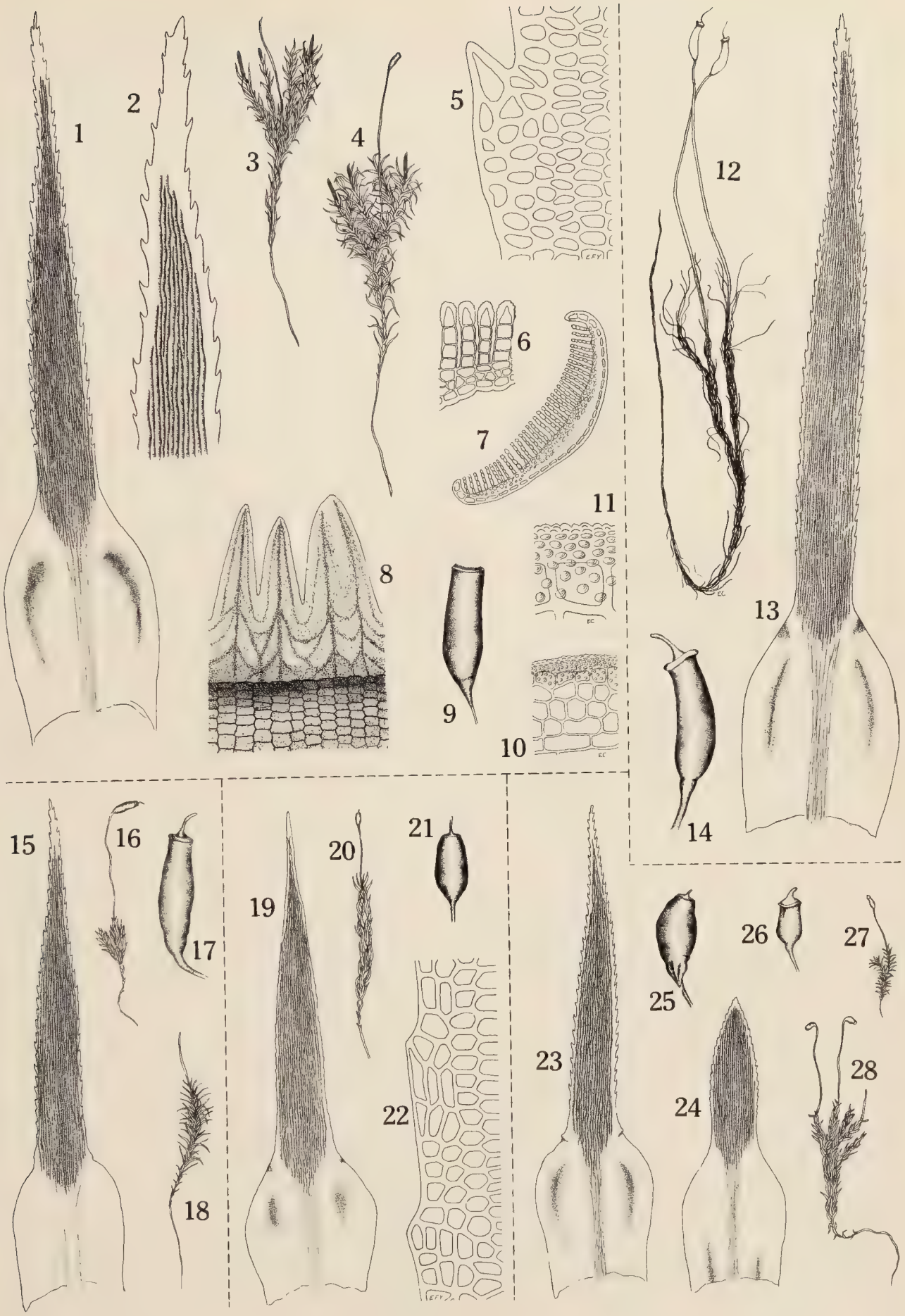
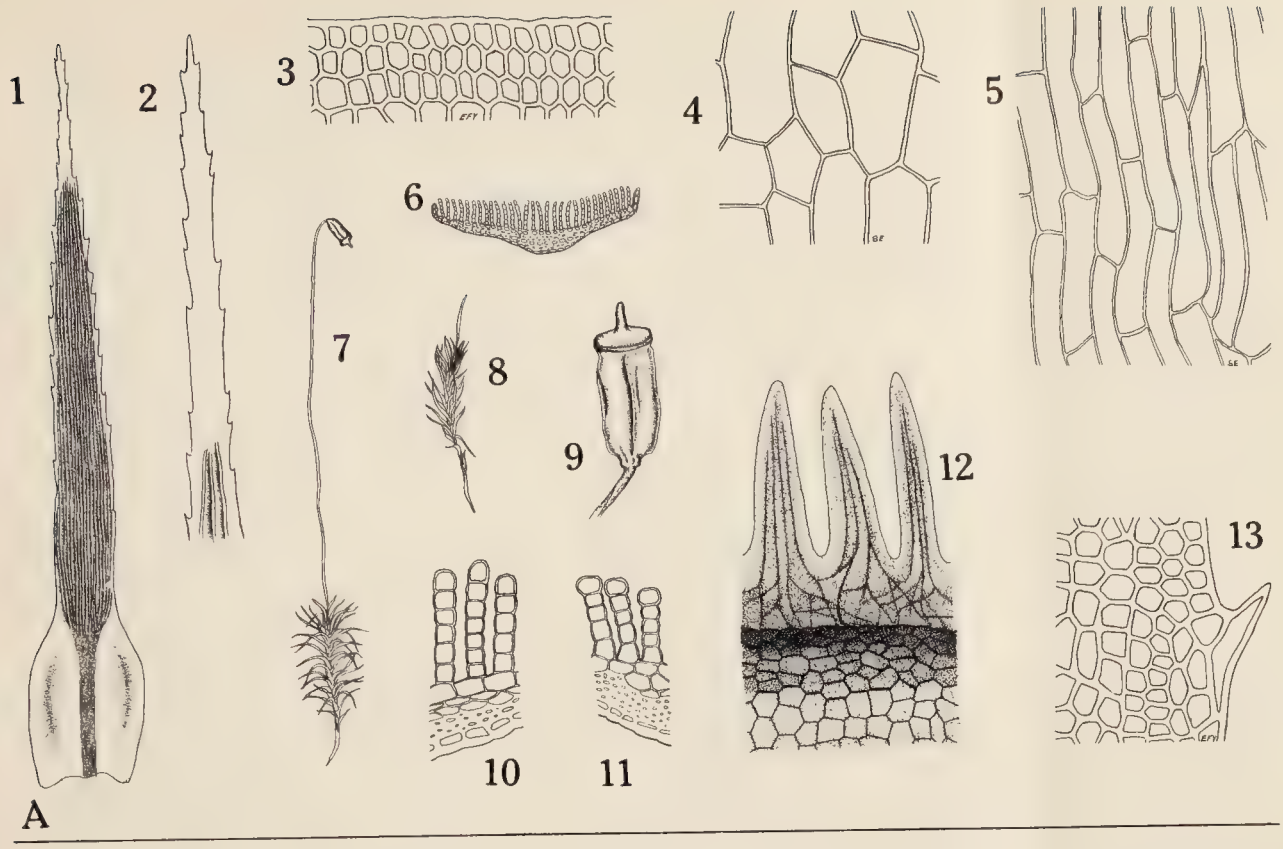


PLATE LX.

PLATE 61. *A*. *Polytrichum formosum* 1–2, 6–12 from Proc. Wash. Acad. Sci. **12**: 311. *f. 19* as *Polytrichum attenuatum*). 1, leaf, × 12; 2, leaf tip, × 45; 3, side view of lamella, × 250; 4, epidermal cells of caspule without surface thin spots, × 250; 5, cells of middle of leaf sheath at about ⅔ distance from margin to costa, × 250; 6, cross section of leaf, × 45; 7, moist plant with capsule, × 0.7; 8, dry plant, × 0.7; 9, capsule, × 3.5; 10, 11, cross sections of a few lamellae, × 180; 12, peristome, × 110; 13, marginal cells about ⅔ up leaf, × 250.

B *Polytrichum gracile* (1–2, 6–11 from Proc. Wash. Acad. Sci. **12**: 310. *f. 18*). 1, leaf, × 12; 2, leaf tip, × 45; 3, side view of lamella, × 250; 4, marginal cells about ⅔ up leaf, × 250; 5, cells of middle of leaf sheath at about ⅔ distance from margin to costa, × 250; 6, moist plant with capsule, × 0.7; 7, dry plant, × 0.7; 8, capsule, × 3.5; 9, cross section of leaf, × 120; 10, cross section of a few lamellae, × 180; 11, peristome, × 110; 12, epidermal cells of capsule without surface thin spot, × 250.



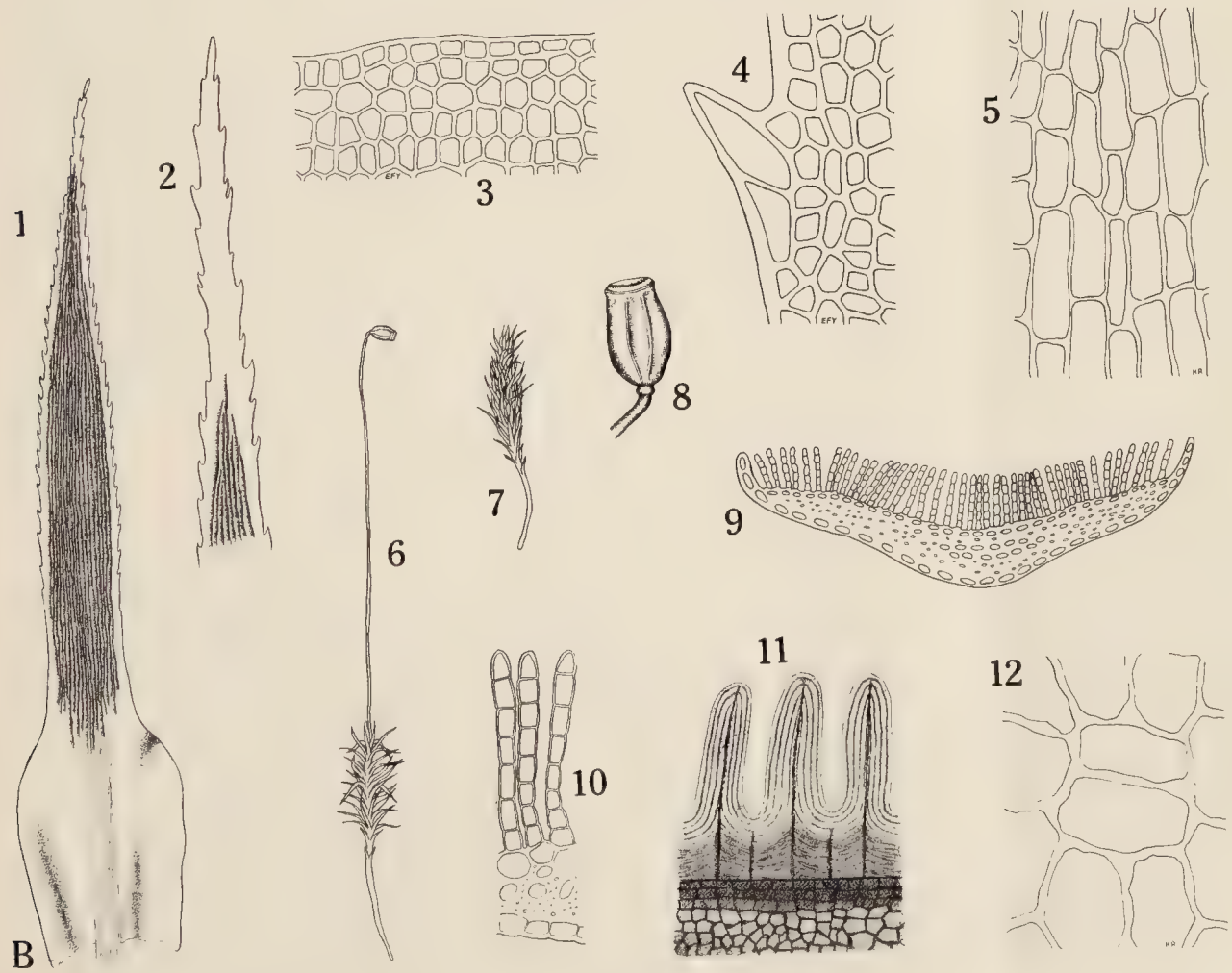
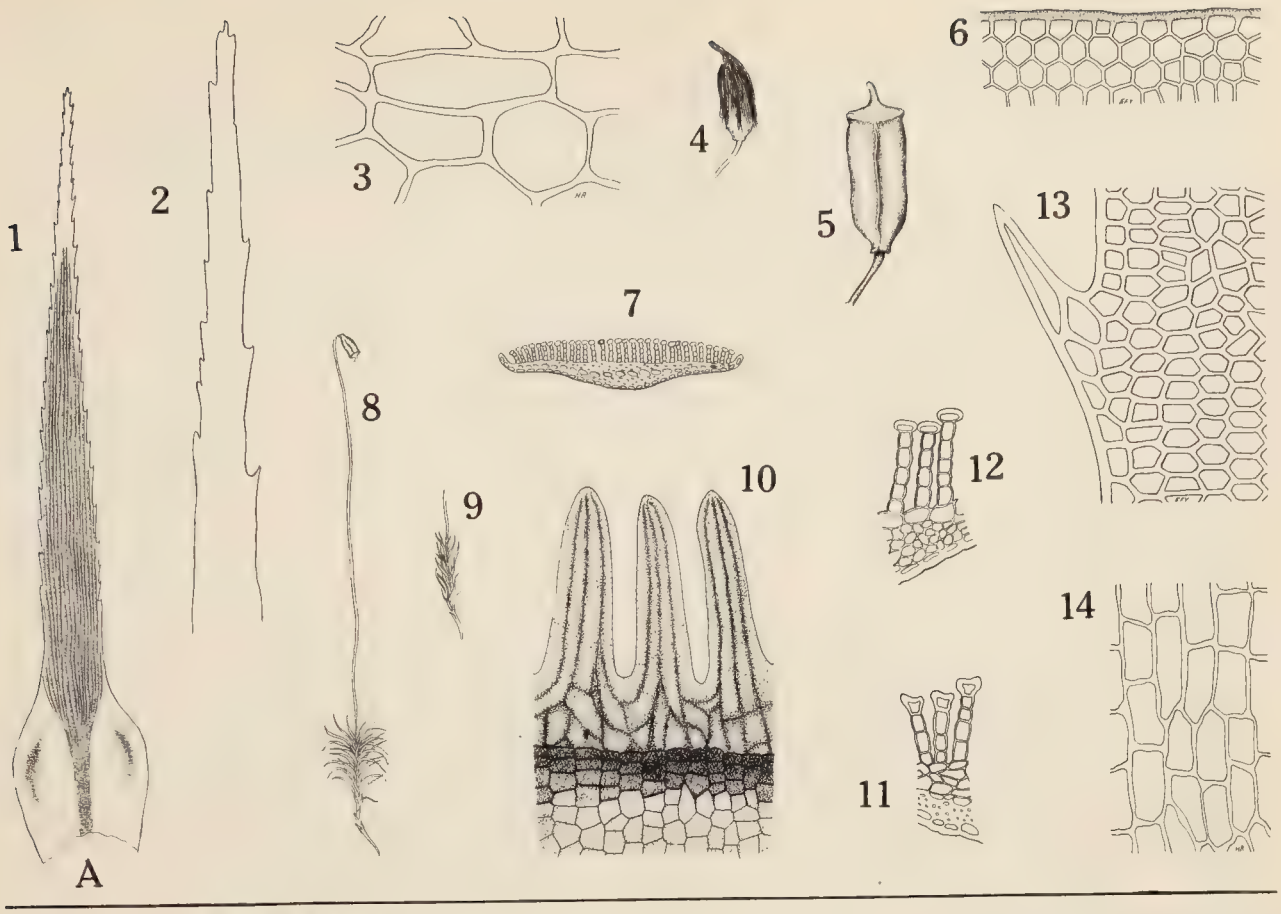


PLATE LXI.

PLATE 62. *A. Polytrichum ohioense* (1–2, 4–5, 7–12 from Proc. Wash. Acad. Sci. **12**: 313. *f. 20*). 1, leaf, × 12; 2, leaf tip, × 45; 3, epidermal cells of capsule without surface thin spots, × 250; 4, immature capsule covered by calyptra, × 3.5; 5, capsule, × 3.5; 6, side view of lamella, × 250; 7, cross section of leaf, × 45; 8, moist plant with capsule, × 0.7; 9, dry plant, × 0.7; 10, peristome, × 110; 11, cross section of a few lamellae just above sheath, × 180; 12, cross section of a few lamellae showing usual form of marginal cells, × 180; 13, marginal cells about ⅔ up leaf, × 250; 14,c ells of middle of leaf sheath at about ⅔ distance from margin to costa, × 250.

B. Polytrichum Swartzii (1–2, 6, 8, 10 from Proc. Wash. Acad. Sci. **12**: 314, *f. 21* as *Polytrichum inconstans*). 1, leaf, × 12; 2, leaf tip, × 45; 3, epidermal cells of capsule with surface thin spots, × 250; 4, capsule, × 10; 5, calyptra, × 10; 6, cross section of part of leaf, about × 45; 7, marginal cells about ⅔ up leaf, × 250; 8, dry plant, × 0.7; 9, dry plant with capsule, × 0.5; 10, moist antheridial plant, *d*, antheridial disk, × 0.7, 11, side view of lamella, × 250; 12, peristome, × 250.



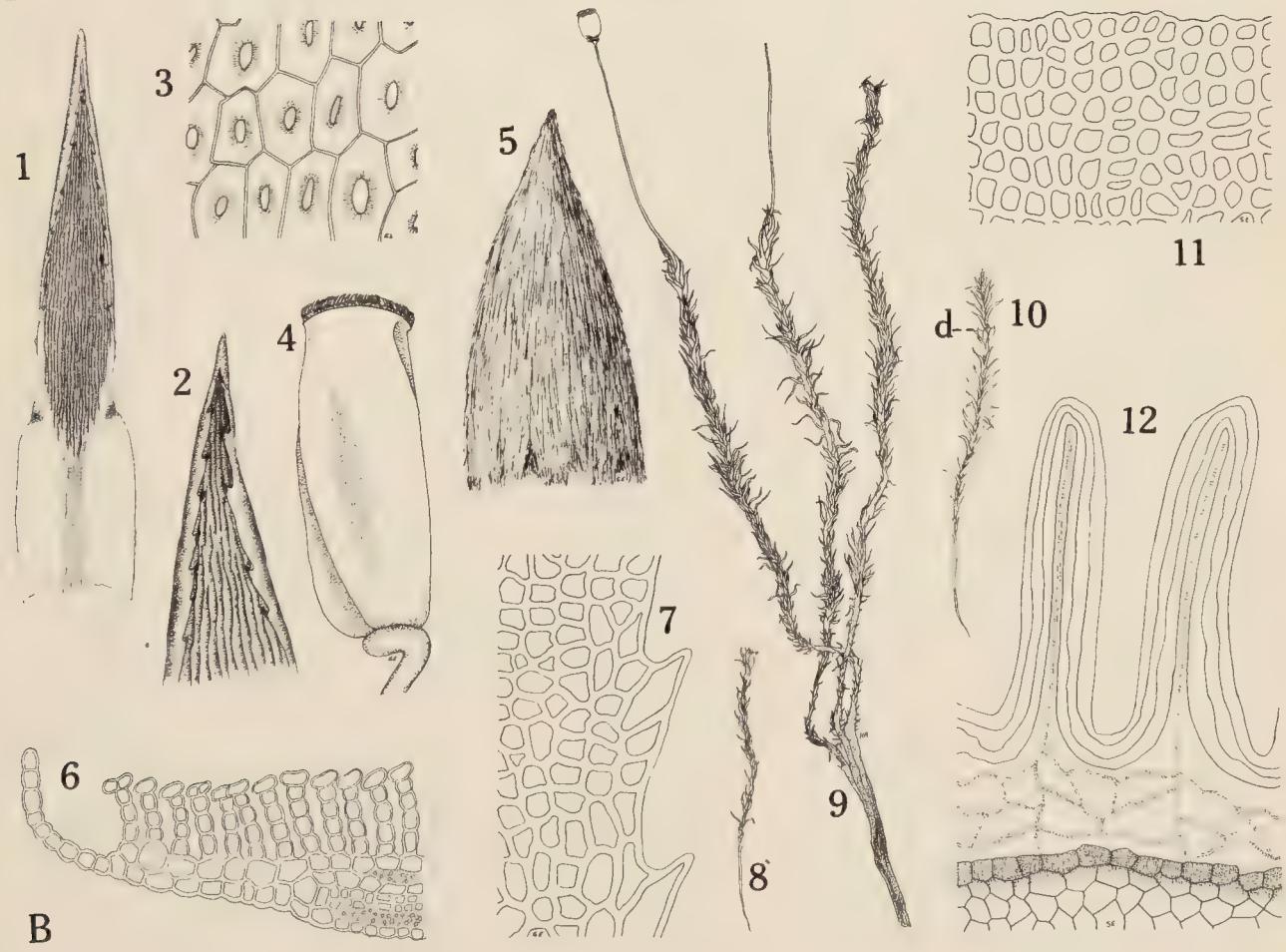


PLATE LXII

PLATE 63. *Polytrichum commune* (1–2, 5–13 from Proc. Wash. Acad. Sci. **12**: 316–318. *f. 22, 23,* in part). 1, dry plant with capsule, × 0.7; 2, dry antheridial plant, *d*, antheridial disk, × 0.7; 3, side view of lamella, × 250; 4, marginal cells about ⅔ up leaf, × 250; 5, peristome, × 110; 6, leaf, × 12; 7, leaf tip, × 45; 8, cross section of leaf, × 45; 9, immature capsule covered by calyptra, × 3.5; 10, epidermal cells of capsule with surface thin spots, × 245; 11, capsule, × 3.5; 12, 13, cross sections of a few lamellae, showing notched marginal cells, × 180.

14–19. *Polytrichum commune* var. *perigoniale* (15–18 from Proc. Wash. Acad. Sci. **12**: 318. *f. 23* in part). 14, side view of lamella, × 250; 15, capsule, × 3.5; 16, epidermal cells of capsule with surface thin spots, × 245; 17, cross section of a few lamellae showing their height and the notched marginal cells, × 180; 18, dry plant with capsule, × 0.7; 19, marginal cells about ⅔ up leaf, × 250.

20–24. *Polytrichum commune* var. *Jensenii* (21–23 from Proc. Wash. Acad. Sci. **12**: 319. *f. 24* as *Polytrichum Jensenii*). 20, side view of lamella, × 250; 21, moist plant, × 0.7; 22, leaf tip, × 45; 23, leaf, × 12; 24, marginal cells about ⅔ up leaf, × 250.

25–30. *Polytrichum commune* var. *yukonense* (25 from Proc. Wash. Acad. Sci. **12**: 320. *f. 25* as *Polytrichum yukonense*). 25, plant, × 0.7; 26, marginal cells about ⅔ up leaf, × 250; 27, side view of lamella, × 250; 28, leaf, × 10; 29, leaf tip, × 67; 30, cross section of leaf showing notched marginal cells of lamella, × 67.

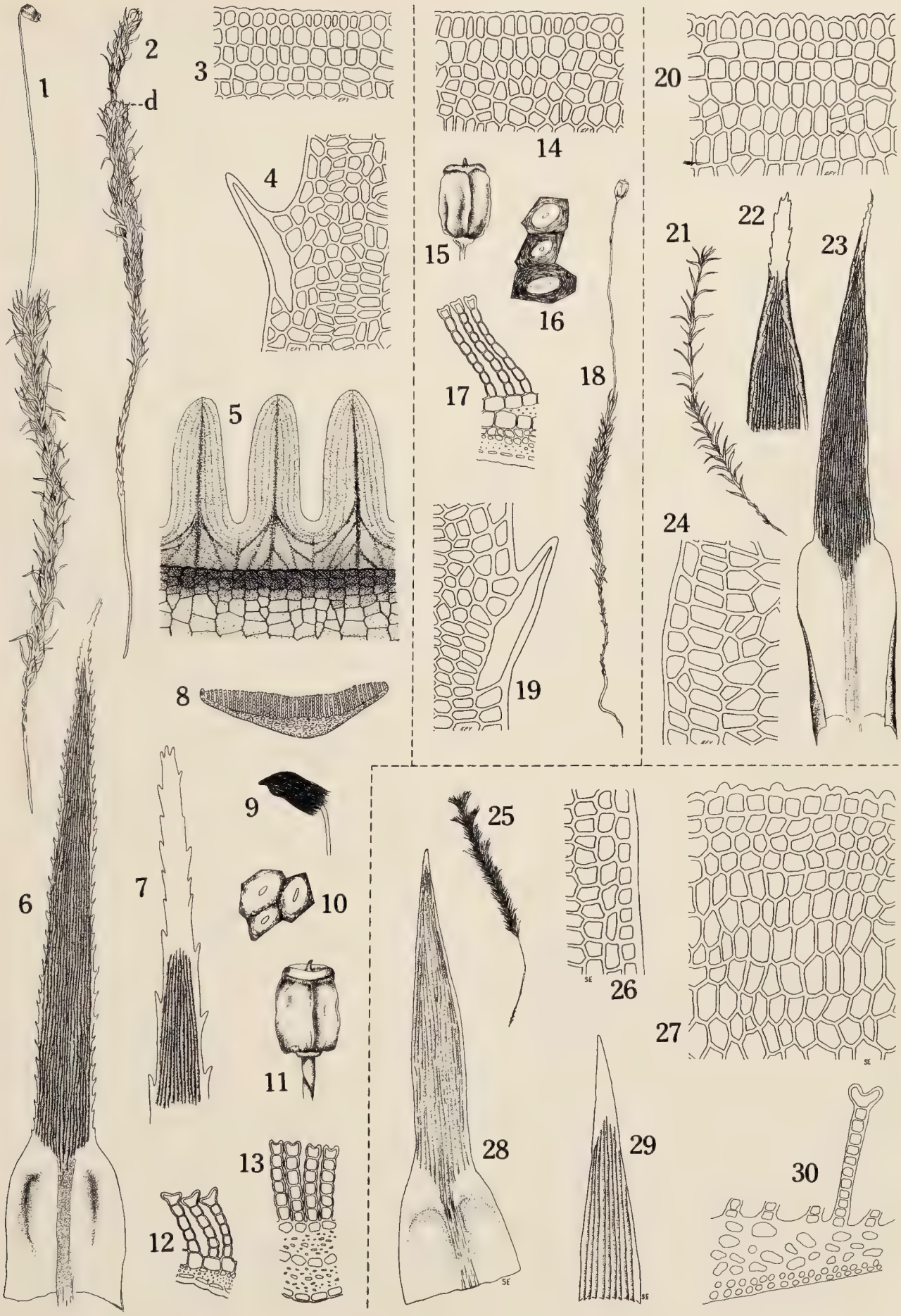

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PLATE LXIII.

PLATE 64. *A. Polytrichum norvegicum* (1–2, 4–6, 8–11 from Proc. Wash. Acad. Sci. **12**: 321. *f. 26* as *P. sexangulare*). 1, moist plant, × 0.7; 2, dry plant, × 0.7; 3, side view of lamella, × 250; 4, leaf tip, showing teeth at back, × 45; 5, cross section of leaf, × 45; 6, leaf, × 12; 7, marginal cells about ⅔ up leaf, × 250; 8, peristome, × 110; 9, immature capsule covered by calyptra, × 3.5; 10, capsule, × 3.5; 11, cross section of a few lamellae, × 180.

B. Polytrichum juniperinum (3–16 from Proc. Wash. Acad. Sci. **12**: 323. *f. 27* and 324. *f. 28* as *P. strictum*). 1, side view of lamella, × 250; 2, marginal cells about ⅔ up leaf, × 250; 3, moist antheridial plant, *d*, antheridial disk, × 0.7; 4, cross section of leaf, × 45; 5, dry plant with capsule, × 0.7; 6, immature capsule covered by calyptra, × 3.5; 7, capsule, × 3.5; 8, cross section of a few lamellae, × 180; 9, leaf, × 12; 10, leaf tip, × 45; 11, peristome, × 110; 12, 13, capsules of var. *alpestre*, × 3.5; 14, immature capsule of var. *alpestre* covered by calyptra, × 3.5; 15, moist plant of var. *alpestre* with capsule, × 0.7; 16, leaf of var. *alpestre*, × 12.

C. Polytrichum piliferum (1–11, 14–15 from Proc. Wash. Acad. Sci. **12**: 327. *f. 30* and 326. *f. 29* as *P. hyperboreum*). 1, leaf tip, × 45; 2, leaf, × 12; 3, moist plant with capsule, × 0.7; 4, dry plant with capsule, × 0.7; 5, 6, 7, capsules, × 3.5; 8, immature capsule with calyptra, × 3.5; 9, cross section of leaf, × 45; 10, cross section of a few lamellae, × 180; 11, peristome, × 110; 12, side view of lamella, × 250; 13, marginal cells about ⅔ up, × 250; 14, dry plant of var. *hyperboreum*, × 0.7; 15, moist plant of var. *hyperboreum* with capsules, × 0.7.

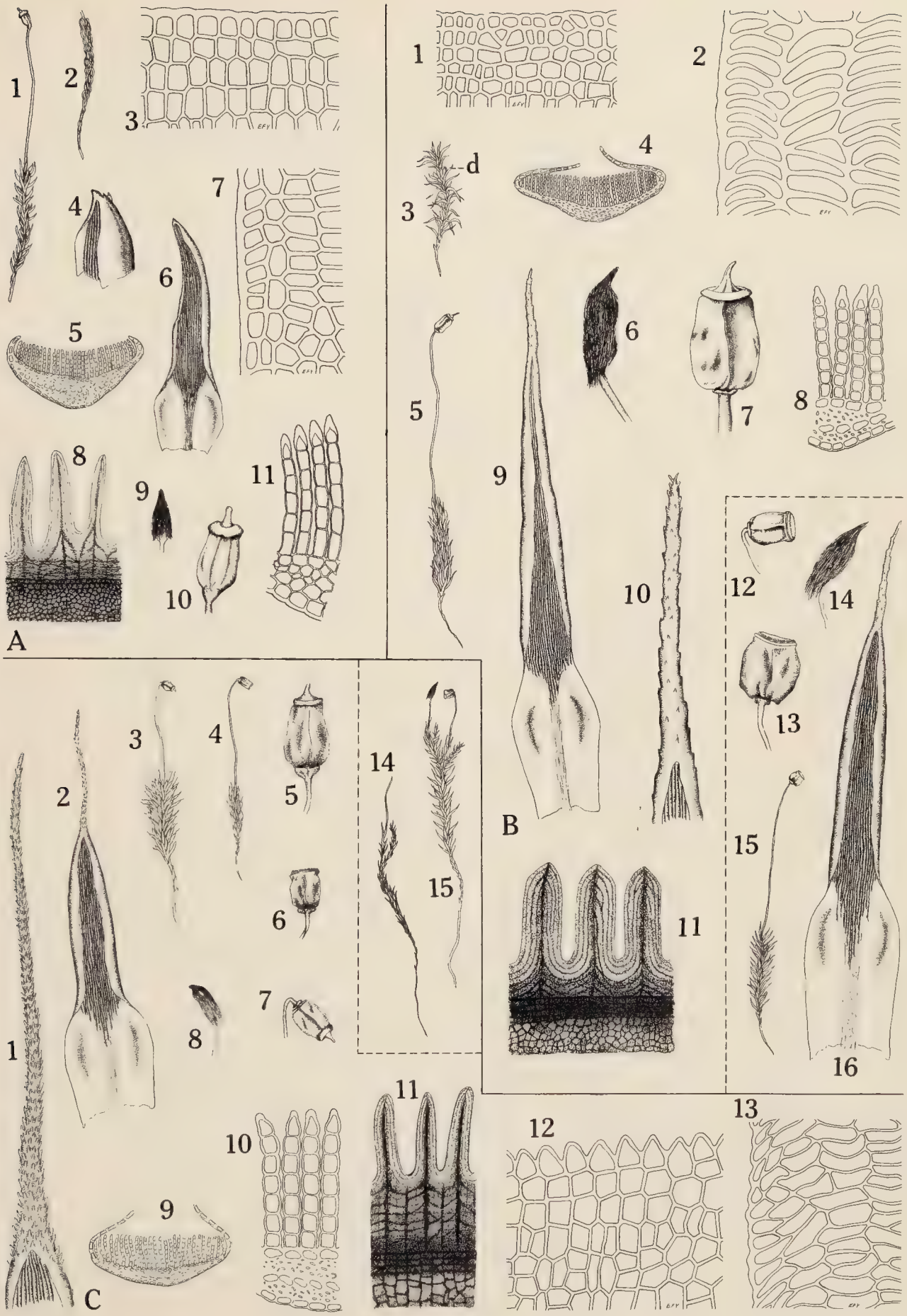


PLATE LXIV.

PLATE 65. *Syrrhopodon floridanus* (at right; from Sulliv., Icones Musc., *pl. 31*). 2, fertile plant; 4, upper part of leaf; 5, 6, base of leaf showing papillose costa; 8, 9, capsules; 11, portion of peristome; 12, vertical section of peristome.

Syrrhopodon texanus (at left; from Sulliv., Icones Musc. Suppl., *pl. 20*). 2, fertile plant; 3, stem leaf; 5, leaf-apex; 6, leaf-base; 7, cross-sections of leaf; brood body from end of costa; 12–15, operculum and calyptra; 16, 17, detail of peristome.

PLATE LXV.

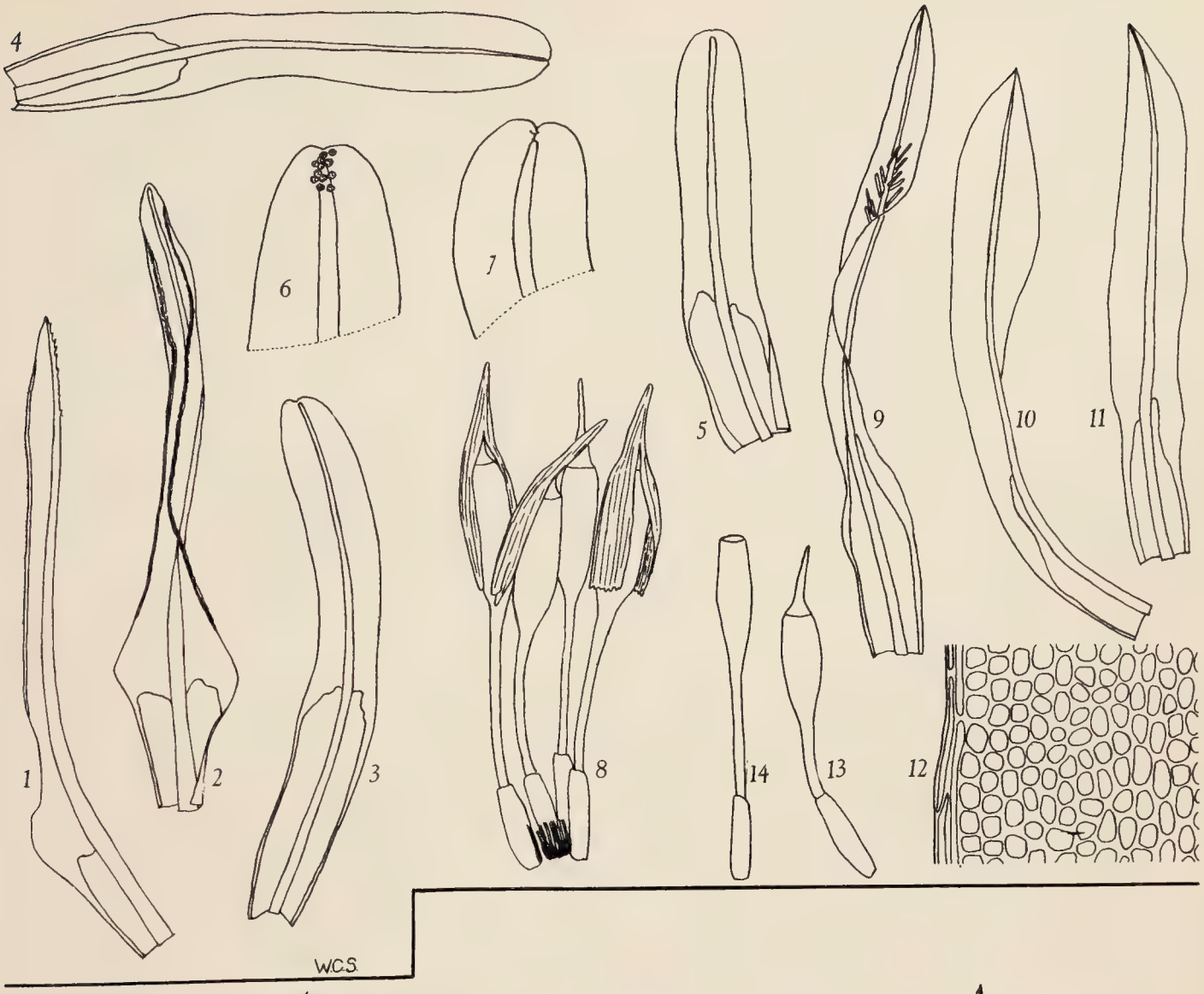
PLATE 66. 1 and 2, *Syrrhopodon incompletus*. Leaves, × 20.

3–7, *Syrrhopodon ligulatus*. 3, 4, 5, leaves, × 40; 6, leaf-apex showing gemmae, × 80; 7, dorsal view of leaf apex, × 80.

8. *Syrrhopodon parasiticus*. Cluster of mature sporophytes, × 10.

9–14, *Syrrhopodon filigerus*. 9, apical, propaguliferous leaf, × 27; 10, 11, leaves, × 27; 12, areolation of upper leaf-margin, × 375; 13, nearly mature sporophyte, × 10; 14, mature sporophyte with deoperculate capsule, × 10.

A. *Syrrhopodon parasiticus* (from Williams, Bryol. **26:** 46). 1, plant, × 1; 2, 3, 4, apical stem leaves, × 20; 5, leaf from a little below the apex, × 20; 6, leaf-apex, × 275; 7, areolation at leaf-margin; 8, cross-section of leaf, × 275; 9, propagulum, × 60.



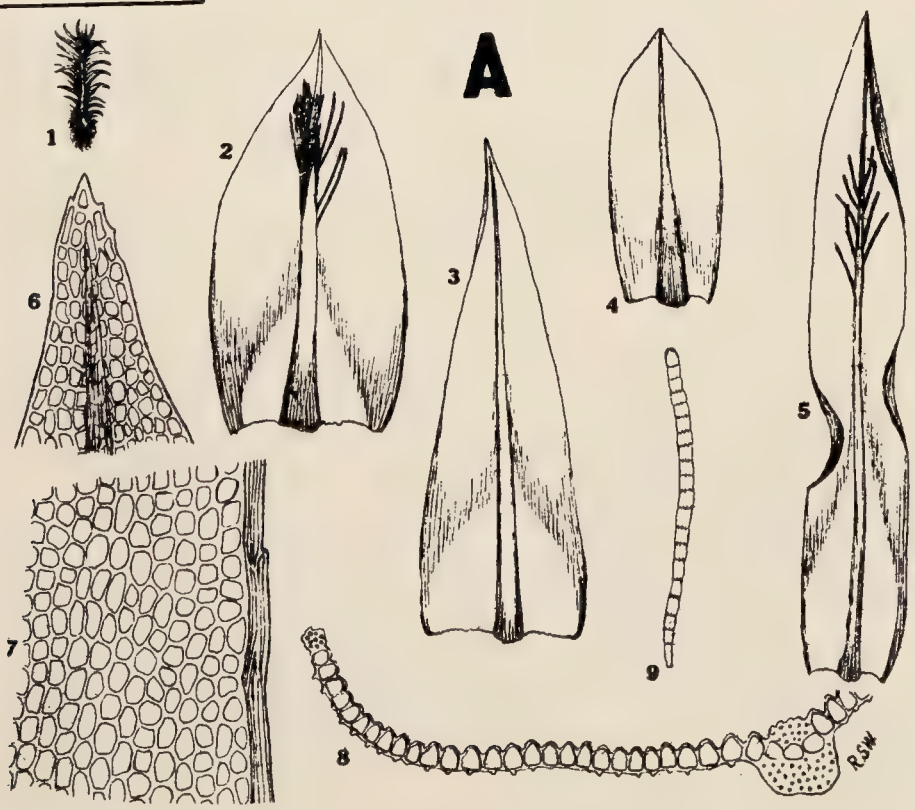


PLATE LXVI.

PLATE 67. 1–5, *Calymperes Nashii*. 1, apical leaf bearing propagula, × 40; 2, propagula, enlarged, × 80; 3, 4, lower leaves, × 40; 5, areolation of upper leaf-base, × 375.

6–11, *Calymperes Richardi*. 6, 7, lower leaves, × 40; 8, 9, upper propaguliferous leaves, × 40; 10, areolation of upper leaf-base, × 375; 11, areolation of upper leaf-margin, × 375.

12–16, *Calymperes emersum*. 12, 13, 14, leaves, × 25; 15, areolation of upper leaf-base, × 375; 16, areolation of upper leaf-margin, × 375.

17–19, *Calymperes Donnellii*. 17, 18, leaves which will bear propagula, × 25; 19, areolation of upper leaf-base, × 375.

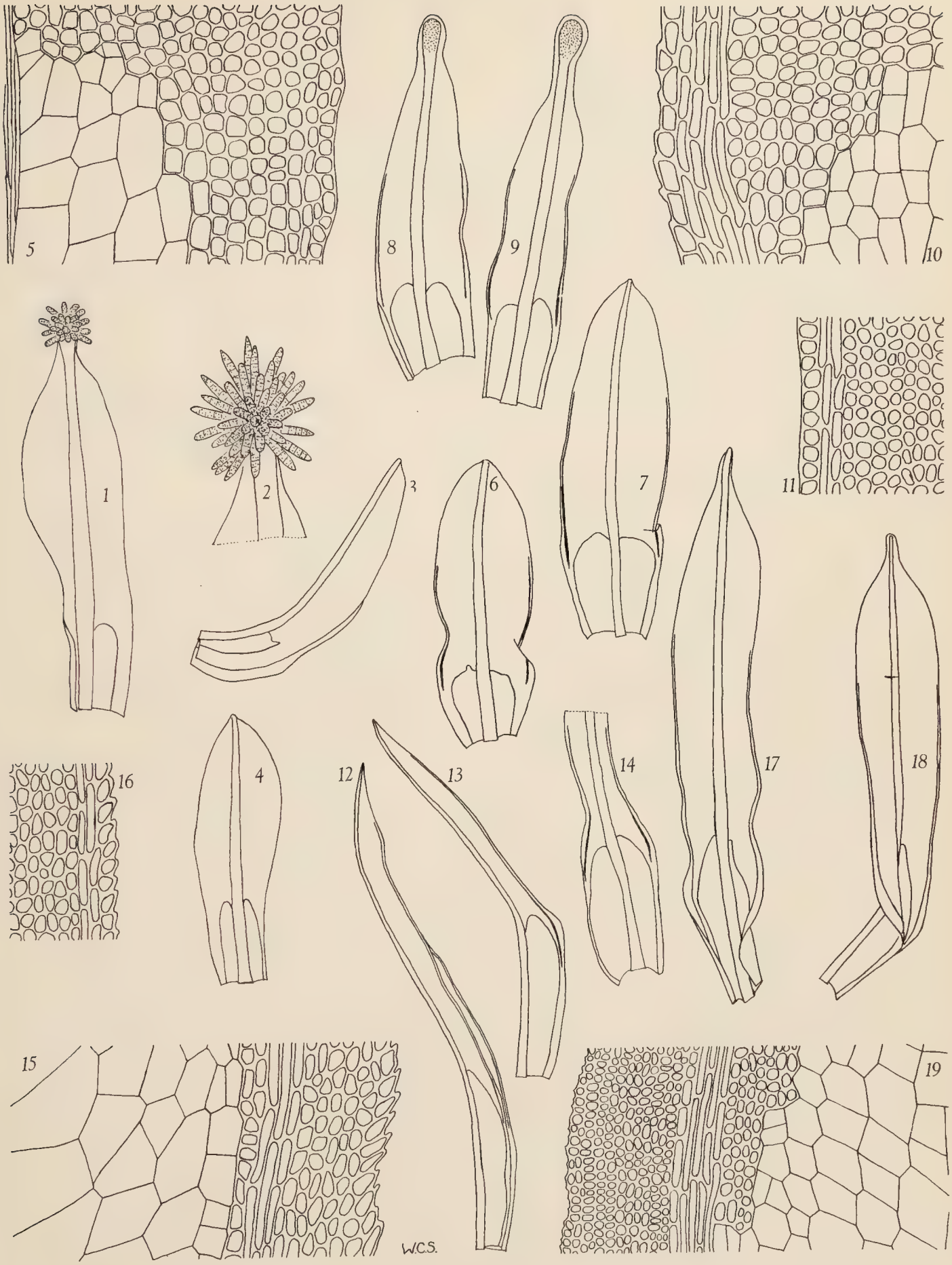


PLATE LXVII.

PLATE 68. A. *Calymperaceae.* (Cross sections ot leaves about midway; from Bull. Torr. Club. **47:** *plates 15–17.*) 1, *Calymperes Richardi,* × 200; 2, *C. emersum,* × 300; 5, *C. Donnellii,* × 300; 8, *C. Nashii,* × 300.

3, *Syrrhopodon floridanus,* × 235; 7, *S. incompletus,* × 235; 16, *S. texanus,* × 235; 17, *S. ligulatus,* × 350; 18, *S. parasiticus,* × 350; 19, *S. filligerus,* × 350.

B. Oncophorus Rauei (from Bryologist **14:** 70). 1, median leaf-cells, × 270; 2, 3, cross sections of eaf, × 270; 4, upper stem leaf, × 16.

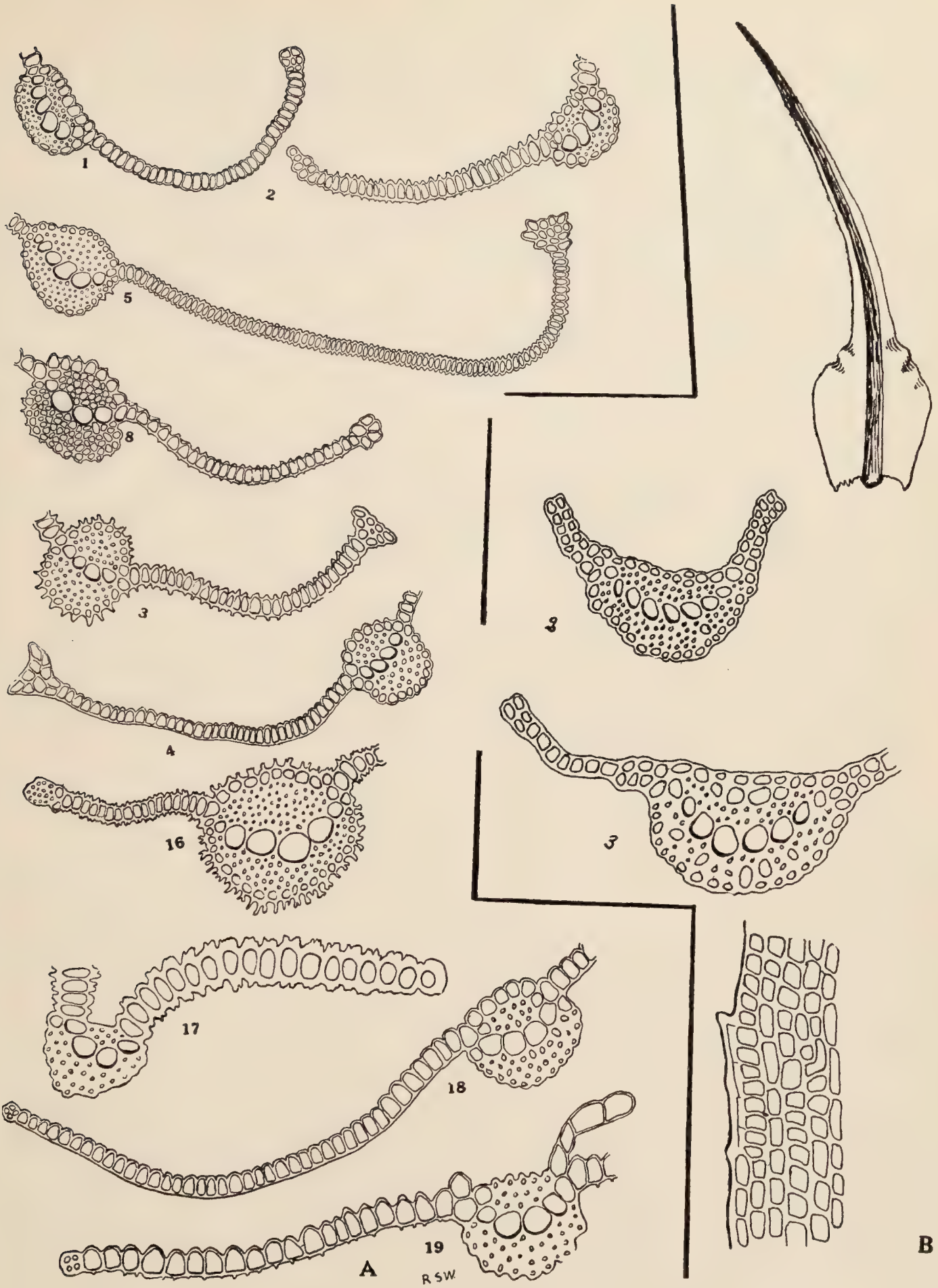


PLATE LXVIII.

MOSS FLORA

OF

NORTH AMERICA

North of Mexico

BY

A. J. GROUT, PH.D.

FELLOW AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE; MEMBER BOTANICAL SOCIETY OF AMERICA; FOUNDER AND ASSOCIATE EDITOR OF THE BRYOLOGIST; MEMBER ALL YEAR STAFF, BIOLOGICAL LABORATORY, COLD SPRING HARBOR, L. I., N. Y.

ENCALYPTACEAE

BY SEVILLE FLOWERS, PH.D.
University of Utah

TORTELLA

BY MRS. INEZ M. HARING, M.A.

DIDYMODON AND BARBULA

BY WILLIAM CAMPBELL STEERE, PH.D.
University of Michigan

VOLUME I

Part 3

PUBLISHED BY THE AUTHOR
NEWFANE, VERMONT
OCTOBER, 1938

Family ENCALYPTACEAE*

By Seville Flowers, Ph.D.

Plants tufted, 0.5–5 cm. high, stems branched, radiculose and reddish or brownish below, green above, leaves crisped or not greatly changed when dry, patent to spreading when moist, ligulate to spatulate, apex broadly rounded to subacuminate, obtuse, mucronate or hair pointed, lamina more or less concave, often cucullate, margins entire or erose dentate by the projecting papillae, plane or revolute; upper median cells more or less isodiametric, quadrate, hexagonal or irregular, somewhat incrassate, 8–30 μ in diameter, papillae simple, forked or lunate; basal cells becoming larger and oblong, up to 90 μ long, the longitudinal walls usually thin, the end walls often thickened, usually reddish, mostly smooth but frequently with projecting end walls, a few forms with strongly papillose basal cells, basal marginal cells linear, thick-walled, paler in color; brood bodies present in many plants, mostly oblong to filamentous, multiseptate, reddish-brown, borne in the axils or on the bases of the leaves. Autoicous or dioicous; setae short, 0.5–3 cm. long, twisted when dry; capsules cylindric, 2.5–5 mm. long, smooth or furrowed when dry, neck short, composed of enlarged cells, mouth bordered by 2–many rows of colored, shorter and thick-walled cells; lid conic or convex, long-beaked; annulus single, double or triple; peristome lacking, simple or double, teeth lanceolate to linear, endostome, when present, forming a pale basal membrane adherent to the teeth, segments adhering or free; spores round or reniform in outline, smooth, wrinkled, papillose or warty; calyptra large, completely covering the capsule or nearly so, cylindric with a short or long beak, yellowish, smooth or scabrous, basal margin erose, lacerate or fringed.

A small but natural family forming a transitional group between the Aplolepideae and Diplolepideae and showing characteristics common to both. It is essentially northern and montane.

ENCALYPTA Schreb. Gen. **2**: 759. No. 1643. 1791; Hedw. Sp. Musc. 60. 1801.

Leersia Hedw. Fundam. **2**: 88. (in part), 1782.

With characteristics of the family.

Plants of rock crevices and soil in both wet and very dry situations; mostly preferring alkaline or lime-bearing substratum. They range from sea-level to the highest mountain peaks. The habitat and varying climatic conditions exert a strong influence on the habit and stature of the plants. It has been noted that in dry situations the tufts are denser and shorter, the leaves more closely disposed and shorter with a tendency to become either very bluntly pointed or rounded, or to become longer hair pointed than is usual; the setae are shorter, the capsule has a tendency to furrow more strongly and the calyptra becomes more strongly papillose or scabrous. Brood bodies have been observed in nearly every species, especially sterile plants of rather moist habitats.

The genus divides itself logically into two groups.

Aplolepideae, plants in which the peristome is single or lacking. *Encalypta alpina*, *E. vulgaris*, *E. rhabdocarpa*, and *E. ciliata*.

Diplolepideae, plants with a double peristome, in some the parts variously united or adherent. *E. apophysata*, *E. brevicolla*, *E. procera* and *E. streptocarpa*.

The phylogenetic relationships of *Encalypta* have been a subject of much discussion and various authors have placed it in various families and by itself. Schimper included it in the Grimmiaceae, K. Muller and Lindberg placed it in the Pottioideae, Hampe made it a subfamily under Calymperaceae, De Notaris and Lesquereux and James placed it under Orthotrichaceae as a subfamily, Dixon makes it a separate family in the Aplolepideae and Fleischer erected a new subgroup for it which he called Heterolepideae. Limpricht makes it a separate family following Orthotrichaceae but does not use a system of subgroups. Philibert (Rev. Bryol. **5**: 1884) regarded *Encalypta* as the meeting point of a three-way relationship. His idea in brief is as follows: (1) The members with a single peristome are related to the Aplolepideae; (2) those with a double peristome are related to the Diplolepideae, and (3) through the European *E. longicolla* the genus is related to *Tetraphis*, *Buxbaumia* and the *Polytrichaceae*. Families must of necessity be placed in a manual in a more or less arbitrary linear arrangement and too often phylogeny is conceived by many as a linear line of affinities. Doubtless many authors have had the polylineate concept but fail to give a complete explanation in many instances.

The gametophyte of *Encalypta* shows a strong relationship to Tortulaceae and to a somewhat less degree to Orthotrichaceae. The broad leaves with strong costae and hair points, short cells, papillae and general habit characteristics are much like those of tortuloid genera. The nature of the papillae are, perhaps, more like those of Orthotrichum.

* Contribution from the biological laboratories of the University of Utah.

KEY TO THE SPECIES.

1.	Peristome lacking or single, teeth lanceolate	2.
	Peristome double, teeth long, linear to filiform, endostome adhering to the teeth, often pale and indistinct	8.
2.	Capsule smooth when dry	3.
	Capsule furrowed when dry	6.
3.	Calyptra not fringed, at most erose	4.
	Calyptra fringed or lacerate or both	5.
4.	Peristome lacking	*2. vulgaris.*
	Peristome present, well developed	*3a. var. subspathulata.*
5.	Peristome lacking, spores finely granular, cells of the fringe not abruptly differentiated	*1. alpina.*
	Peristome present, spores wrinkled, cells of the fringe bordered above by 2–many rows of smaller quadrate cells	*4. ciliata.*
6.	Peristome present, often with preperistome	*3. rhabdocarpa.*
	Peristome lacking	7.
7.	Spores 24–35 μ, with rounded distinct papillae	*2. vulgaris.*
	Spores 35–55 μ, with large warty papillae	*3. rhabdocarpa.*
8.	Capsules smooth when dry	9.
	Capsules spirally furrowed when dry	10.
9.	Basal cells of the leaves strongly papillose	*5. apophysata.*
	Basal cells of the leaves smooth, teeth more or less united in pairs, not split above	*6. brevicolla.*
10.	Monoicous, stems with central strand, seta smooth, segments not split, spores 16–18 μ, granular within	*7. procera.*
	Dioicous, stems without central strand, seta rough above, segments split into 32 filiform divisions, spores 8–12 μ, smooth	*8. streptocarpa.*

1. ENCALYPTA ALPINA Smith. Engl. Bot. **20**: *pl. 1419.* 1805.

Encalypta affinis Hedw. f. Weber & Mohr's Beitr. **1**: *pl. 4.* 121. Mr. 1805.
Encalypta commutata Nees & Hornsch. Bryol. Germ. **2**[1]: 46. *pl. 15.* 1827.
Leersia alpina Lindb. Musci Scand. 20. 1879.

Plants rather large, 2–5 cm. high, in dense or loose tufts; stems slightly branched, brown below, green at the tips; leaves not or only slightly crisped when dry, upper ones *recurved to squarrose* when moist, 3–4.5 mm. long, oblong-lanceolate, the apex tapering to a short or long hair point; costa red and prominent at the back but not as stout as in other species, shortly or longly excurrent forming an arista; margins entire, plane or incurved; *base long, very concave and clasping, often tube-like, broadest at the junction with the lamina above which diverges rather abruptly, forming shoulders;* area of oblong basal cells extending to the shoulders, becoming rhomboidal at the junction, usually red, broader below, 16–20 μ wide, margin bordered by linear, thick-walled cells, paler; upper median cells rounded to hexagonal or irregular, 10–16 μ in diameter, chlorophyllose and indistinct, papillae simple, forked or lunate, very dense but not very high. Autoicous; perichaetium terminal, leaves with longer and more strongly clasping bases, tube-like or convolute, upper lamina abruptly patent, short, acute at the apex; costa shortly excurrent. Perigonium lateral, below the perichaetium, inner leaves small, base broad and clasping, upper lamina short, erect or divergent, outer leaves much like those of the stem; vaginule about 1 mm. long, seta 7–10 mm. long, twisted when dry; capsule slenderly cylindric, 2–3.2 mm. long, 0.6–0.8 mm. wide, not including lid, lid long beaked, up to 1.5 mm. long, mouth small, bordered by 2–4 rows of short colored cells, *surface smooth when dry or very faintly striate but not furrowed; stomata large and broad, only in the neck region; peristome lacking;* spores 32–38 μ in diameter, round to irregular, pale yellowish, finely papillose or granular; calyptra large, descending below the base of the capsule, *5.5–10 mm. long,* beak short or long, *smooth throughout, base with strongly incurved fringe composed of undifferentiated cells which merge imperceptibly with those of the base of the calyptra, at first not or only slightly lacerate, but with age straightening out and becoming very irregularly lacerated,* often fugaceous leaving a ragged basal margin. Type locality, European.

ILLUSTRATIONS:—Engl. Bot. l. c.; Weber & Mohr, l. c.; Schwaegr. Suppl. 1[1]: *pl. 16.* 1811 (as *E. affinis*); Bryol. Eur. *pl. 198; Pl. 71C.*

EXSICCATI:—Macoun, Can. Musci 362 (in part as *E. commutata*), 71a & 131 (as *E. rhabdocarpa*); Leiberg 791 (in part as *E. rhabdocarpa*); Drummond, Musci Am. 49 (as *E. affinis*).

An alpine and boreal species growing in the crevices of rocks and on the soil from Alaska to Colorado, British Columbia and Washington. It has been reported from Greenland.

This is a rather uncommon plant and is often found growing in mixture with other members of the genus. The tapering leaves, broadest in the middle, the slender smooth capsules without a peristome, with large stomata in the neck, and the calyptra characters make it easily identified, Some of the specimens in Macoun's Canadian Musci issued under number 131 are *E. alpina*, others partly *E. rhabdocarpa* and still others are apparently all *E. rhabdocarpa*.

2. ENCALYPTA VULGARIS Hedw. Sp. Musc. 60. 1801.

Leersia extinctoria Hedw. Fundam. **2**: 88. 1782.
Leersia marginata Hedw. Fundam. **2**: 103. 1782.
Encalypta cucullata C. Mull. & Kindb.; Macoun, Cat. Can. Pl. **6**: 96, in part. 1892.
Encalypta extinctoria subsp. *enella* Kindb. Röll, Hedwigia **35**: 65. 1896.

Plants in dense tufts, stems 0.5–2 cm. high, branched, radiculose below, brownish or reddish in the lower portion, green at the tips; leaves not or only slightly crisped when dry, open to recurved when moist, oblong-ligulate to spatulate, apex acute, mucronate or shortly piliferous, lamina flat, incurved or cucullate; costa stout, prominent at the back, mostly strongly papillose but often smooth, especially above, ending below the apex, percurrent or extending into a short hair point; margins plane or revolute from the middle downward, erose dentate by the projecting papillae; upper median leaf cells isodiametric to irregularly hexagonal, 12–16 μ in diameter, papillae dense, simple, forked or lunate, 2–6 per cell; basal median cells larger, oblong, 14–18 x 20–60 μ, reddish, the end walls usually thickened, basal marginal cells linear, thick-walled, forming a paler border, smooth or slightly papillose. Monoicous; perichaetia terminal, outer leaves similar to the stem leaves, inner ones shorter but with longer points; perigonia borne just below the perichaetia, leaves shorter, clasping, base long, points shorter; vaginule 1–1.5 mm. long; setae 2.5–12 mm. long, smooth or slightly twisted when dry, yellowish, becoming reddish with age; capsules cylindric, about 3 mm. long and up to 1 mm. wide, *smooth or minutely wrinkled when dry, often striate and becoming strongly furrowed when old and empty;* exothecial cells thin-walled or with longitudinal striae of thicker-walled colored cells, mouth bordered by 2–3 rows of quadrate colored cells, neck short, cells larger; stomata distributed over the surface uniformly; lid conic, long beaked, 1–1.5 mm. long; annulus single; *peristome mostly lacking,* when present short and fugaceous; spores reniform or round in outline, 24–35 μ, *with rounded, distinct papillae, 3.2–4.8 μ in diameter;* calyptra cylindric, about 4.5 mm. long, beak tapering and rather short or longer and clavate, base pale, slightly ragged, surface variously papillose, often only the beak papillose, smooth below, or, the entire calyptra densely scabrous. Type locality, European.

ILLUSTRATIONS:—M.H.M. 172. *fig. 81*; Dixon & Jam. Handb. British Mosses (*Ed. 3*) 21A; Bryol. Eur. *pl. 199; Pl. 69A.*

EXSICCATI:—Grout, N. A. Musci Perf. 108; Holzinger, Musci Acro. Bor. Amer. 214; Macoun Can. Musci 419 (as *E. cucullata*).

In crevices and on soil throughout the Rocky Mountains and westward.

This species is uncommon in North America and the collections are few. By far the greatest number of plants referred to this species represent the following varieties which are very easily distinguished.

2a. Var. APICULATA Wahl. Fl. Lapp. 344. 1812.

Leaf apices hair pointed, often very long, costa usually extending into the hair point; capsules more constantly ribbed or furrowed. Type locality European. Range as in the species.

ILLUSTRATIONS:—*Pl. 69A7.*

EXSICCATI:—Grout, N. A. Musci Perf. 243 (in part); Holzinger, Musci Acro. Bor. Amer. 655 (as var. *pilifera*); Macoun, Can. Musci 365 (as *E. subspathulata*); Leiberg 242; and 368 (as the species), and 368, 787 & 793 (as *E. rhabdocarpa*); Sandberg & Leiberg 844 (as *E. alpina*).

This variety seems to occur more frequently on soil than in crevices and is often slightly smaller in stature and less densely tufted than the species. The capsules are usually smaller and strongly ribbed. On this account a large number of the collections have been referred to *E. rhabdocarpa.* The absence of the peristome and the smaller spores with distinct papillae which are large but not warty make it fairly easy to distinguish.

2b. Var. MUTICA Brid. Musc. Recent. Suppl. **4**: 28. 1819.

Encalypta vulgaris var. *obtusa* Nees & Hornsch. Bryol. Germ. **2**: 35. 1827.

Tufts very dense and compact, leaves obtuse to very broadly rounded, costa ending well below the apex, capsules more constantly ribbed and furrowed when dry, calyptra often very scabrous to the base. Type locality European.

ILLUSTRATION:—*Pl. 69A-2, 4, 8, 9.*

EXSICCATI:—Grout, N. A. Musci Perf. 243 (in part); Holzinger, Musci Acro. Bor. Amer. 464; Watson 1397, 1398; Leiberg 792, 794; Brinkman 207; Coville & Funston 660 (as var. *trachymitra*); Flowers, Utah Mosses 15.

This variety is predominantly a crevice plant. It forms large tufts in moist canyons and even grows on the tops of barren, windswept peaks above 13,000 feet elevation. In the low basin ranges and even on the soil in the dry desert regions of the Great Basin it forms short and more compact tufts with the capsules emergent. There are many variations both in stature and structural details, some tending toward the species while several extreme forms are worthy of mention. Some forms from extremely dry desert situations show a very large and broad costa with a boat-shaped lamina. In regions of climatic extremes, the young leaves often show cells that are larger than typical. Where the plants are very limited in growth, all the leaves have the larger cells which seems to be entirely a habitat effect. Var. *lunata* Bart. & Chamb. (Bryol. **28**: 4. 1925) is an intermediate form leaning toward the species in leaf characteristics and toward var. *mutica* in capsule characteristics. The lunate papillae are prominent but nearly every species of *Encalypta* show them in varying degrees.

Encalypta vulgaris is a variable plant and has often been confused with *E. rhabdocarpa* because North American plants of these species vary strongly toward one another and many of their characteristics are not as strongly contrasted as is apparent in European specimens. Most manuals separate the two on the bases of smooth capsules without a peristome in *E. vulgaris*, a furrowed capsule with a peristome in *E. rhabdocarpa*. Relatively few American plants of *E. vulgaris* have smooth or minutely wrinkled capsules while the great majority are ribbed or furrowed. Both plants show capsules that are smooth or nearly so and parallel forms showing various degrees of furrowing may be traced. Usually the young or mature capsule has reddish or orange-colored striae or ribs and with age it becomes more or less shrunken and strongly furrowed. *E. vulgaris* vars. *apiculata* and *mutica* nearly always show a ribbed capsule at maturity before the spores are shed. The former is a parallel form of *E. rhabdocarpa* while *E. vulgaris* has a parallel form in *E. rhab.* var. *subspathulata*. A very weak and fugaceous peristome is sometimes formed in *E. vulgaris* but it is seldom seen. *E. rhabdocarpa* may be identified in the field if the peristome has not fallen, but in most of the specimens in the various herbaria the peristome had fallen when collected and it was difficult to separate them from *E. vulgaris* and its varieties. Mrs. MacFadden's fine specimens from British Columbia have smooth capsules with a peristome and fits the description of *E. subspathulata* C. Mull. & Kindb. perfectly. A careful study of this plant indicates that it is a relative of *E. rhabdocarpa*, and represents an extreme form with smooth capsules. There is no preperistome, but in all other characteristics it approaches the latter species. Miss Coker, l. c., makes *E. subspathulata* a synonym of *E. rhabdocarpa*. In European plants Limpricht, et al. require small, strongly papillose spores, 26–30 μ, for *E. vulgaris*, and larger, warty spores, 40–55 μ for *E. rhabdocarpa*. These contrasts are fairly well borne out by European exsiccati I have seen, but in North American plants the spore size in each overlaps markedly although the papillae are more constant. The coarse papillae are rounded and distinct, 3.2–4.8 μ measured under oil immersion objectives while the warty papillae are less distinct, more or less impinging upon one another giving the spore the appearance of a raspberry or mulberry, and measure 6.4–8.0 μ in diameter. Miss Coker, l. c., separates the two species in part on the basis of the thickened end walls of the basal cells in *E. vulgaris*, and the thin end walls of the basal cells of *E. rhabdocarpa*. I find that the end walls are thickened in both species, and in some plants they are thin-walled. In fact the thick end walls of the basal cells seem to be characteristic of the leaves throughout the genus.

Plants with peristomate capsules, either smooth or furrowed may be assigned to *E. rhabdocarpa*, and in the absence of the peristome the large warty spores will serve to identify the plant as this species in some cases. Plants may be referred to *E. vulgaris* if the peristome is absent and the spores are of the smaller size. In cases where the capsules are furrowed and the spores are of intermediate size and surface papillae the species becomes questionable. Unfortunately a large number of North American plants fall into this uncertain group and will always be a problem for the moss student.

3. ENCALYPTA RHABDOCARPA Schwaegr. Suppl. **1**: 56. 1811.

Leersia rhabdocarpa Lindb. Musci Scand. 26. 1879.
Encalypta rhabdocarpa var. *leiomitra* Kindb. Ottawa Nat. **4**: 61. 1890.
Encalypta leiomitra Kindb.; Macoun, Cat. Can. Pl. **6**: 93. 1892.

Plants in dense tufts, brownish and radiculose below, green above; stems 0.5–2 cm. high, branched; leaves crisped when dry, patent to recurved when moist, oblong-ovate to spatulate, 3–5 mm. long, apex

broadly rounded, usually apiculate, or tapering and pilifeous, the point hyaline, wide or very long and slender, often 2 mm. long; costa stout, ending below the apex or percurrent, sometimes entering the base of the hair point, prominent at the back, red at the base, smooth or papillose; lamina concave or cucullate, sometimes nearly plane, margins erect, entire except for the projecting papillae, lower lamina red, often including the lower half of the leaf, base plane to strongly concave and subclasping; upper median leaf cells rounded to quadrate or hexagonal, 12–18 μ in diameter, chlorophyllose, papillae simple, forked or lunate, sometimes circular or of irregularly branched ridges; basal cells oblong, usually highly colored, 15–20 μ wide, 28–72 μ long, the end wall usually heavily thickened with projections at the angles, margin with 6–10 rows of linear, thick-walled cells, paler in color. Autoicous; perichaetium terminal, inner leaves short, broadly ovate to oblong, base clasping, red, apex abruptly narrowed, mucronate, costa ending below the apex, outer leaves much like those of the stem but with longer hair points; perigonia lateral, just below the perichaetium, leaves much shorter, base clasping, oblong to ovate, apex short and abruptly narrowed and divergent, obtuse or acute, costa ending below the apex, or percurrent, outer leaves few, like those of the stem; vaginule about 1 mm. long; seta 8–10 mm. long, straight or twisted when dry, yellowish, red near base of capsule; capsules cylindric, 2.5–3 mm. long and up to 1 mm. wide, mouth and base red, lid conic, long beaked, 1–1.5 mm. long; urn striped with reddish lines, neck short, cells larger, stomata mostly in the lower half of the urn, when dry longitudinally furrowed; annulus double, mouth bordered by two rows of quadrate, red, thick-walled cells; *peristome of 16 lanceolate teeth*, incurved, reddish, 7–9 jointed, up to 0.6 mm. high, preperistome prominent, rising 2–5 joints up each side of the tooth, occasionally lacking; *spores large, 35–55 μ in diameter, beset with large warty papillae, 6.5–8 μ in diameter;* calyptra reaching the base of the capsule, cylindric, mostly 4–5 mm. long, beak tapering or clavate, 1.5–2 mm. long, tip dark, smooth to scabrous, occasionally the entire calyptra slightly scabrous, basal margin entire or slightly ragged, pale. Type locality, Alps in Europe.

Illustrations:—Coker, Bull. Torr. Club **45**: *pl. 13B;* Schwaegr. l. c. *pl. 16;* Bryol. Eur. *pl. 205; Pl. 69B.*

Exsiccati:—Macoun, Can. Musci 131 and 362 (in part), 364, Can. Mosses 84; Leiberg 791 (in part), 790, 797, 798, 1301; Musci Leibergiana 153 (in part); MacFadden 59, 888, 889, 892, and 902; Holzinger Musci Acro. Bor. Amer. 405 (in part); Kaiser Bry. So. & Cent. B. C. 813; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 112, (Ed. 2) 166; Drummond, Musci Am. 50, 51 (in part) & 52.

Plants of rock crevices and soil, British Columbia, Alaska, Montana, California, Idaho, Colorado, Ontario.

See notes under *E. vulgaris* for comparison.

The presence of a peristome, furrowed capsule, large warty spores and piliferous leaves are outstanding characteristics of typical plants. The plant seems to be more abundant in the Pacific Northwest, and is favored by a more humid climate. Southward and especially in the Great Basin it is less common and is replaced by *E. vulgaris*.

3a. Var. subspathulata (C. Mull. & Kindb.) **n. comb.**

Encalypta subspathulata C. Mull. & Kindb. Macoun, Cat. Can. Pl. **6**: 93. 1892.

Plants shorter than typical *E. rhabdocarpa*, habit and leaves much the same; *capsules longer cylindric, mouth rather small, smooth, finely wrinkled or faintly ribbed when dry; peristome present, without preperistome,* teeth lanceolate, somewhat irregular, finely papillose; *spores 28–35 μ, with large warty papillae.* Type locality in British Columbia.

Exsiccati: MacFadden, 897.

This plant has been questionable for some time. Miss Coker makes it a synonym of *E. rhabdocarpa* and adds a note to the effect that the older capsules were badly infected with fungi. This apparently refers to the type specimen. In many cases considerable uncertainty exists as to the type specimen of many of the mosses described by Kindberg and his associates in erecting new species. Mrs. MacFadden's plant is very convincing and has both young operculate capsules, very faintly ribbed below the mouth and older capsules that are almost perfectly smooth and with good peristomes. The shape and contour of the capsule is almost the same as that of *E. alpina*, which see.

3b. Var. microstoma Breidler; Limpr. Laubm. **2**: 115. 1895.

Capsule narrowing to a small mouth. Lid small, extended into a long point; peristome perfect or rudimentary. In alpine regions of the Rocky Mountains, also in Europe. No specimens of this plant were available for study and it is included on the authority of authors.

I cannot distinguish var. *pilifera* (Funck) Nees & Hornsch. from the species. The leaves are said to be broader with a long spinulose hair point. Similar variations appear in nearly every other species with piliferous leaves.

4. ENCALYPTA CILIATA Hedw. Sp. Musc. 61. 1801.

Leersia laciniata Hedw. Fundam. **2**: 103. *pl. 5, f. 24a.* 1782.
Leersia ciliata Hedw. Stirp. Crypt. **1**: 49. *pl. 19.* 1787.
Encalypta laciniata (Hedw.) Lindb. Acta Soc. Sc. Fenn. **10**: 267. 1872.
Encalypta mexicana C. Mull. Syn. **1**: 516. 1849.
Encalypta alaskana Kindb.; Macoun, Cat. Can. Pl. **6**: 269. 1892.

Plants in dense tufts up to 4 cm. high, brown and radiculose below, bright green above; stems branched, leaves crisped when dry, sometimes not greatly altered, imbricated, patent to recurved when moist, oblong-ovate to ligulate, 2.5–5 mm. long, apex abruptly contracted to a short point from a rather broad upper lamina or tapering to a longer point; margins plane or incurved, concave, often revolute at the base; costa stout, shortly excurrent or ending below the apex, reddish, prominent at the back, papillose; upper median cells hexagonal, rounded or irregular, 10–17 μ in diameter, moderately papillose with simple, forked or lunate papillae, 2–6 to a cell, chlorophyllose, sometimes clear; leaf base usually concave and subclasping, often abruptly narrowed below the upper portion of the lamina, cells hyaline or colored, 14–22 μ wide and up to 70 μ long, marginal cells linear, thicker walled and often paler, papillae lacking. Autoicous; perichaetial leaves much like those of the stem, inner ones shorter, bases broader and clasping, upper lamina short, abruptly differentiated and divergent, costa percurrent; perigonial leaves short, base long and clasping, hyaline or colored, upper lamina short, a few outer leaves with longer points; vaginule 1–1.4 mm. long; seta about 1 cm. long; capsule cylindric, yellowish or brown, 2–3 mm. long, lid conic, long-beaked, 1–1.5 mm. long, urn smooth or minutely rugulose when dry, base sometimes twisted, stomata large, on lower half; *peristome simple*, teeth 16, reddish, lanceolate, 0.32–0.42 mm. long, arising deeply within the mouth, 6–9 jointed, *finely longitudinally striate with coarser simple papillae here and there* or *occasionally densely and finely papillose;* annulus single, large, mouth of capsule bordered by 2–5 rows of red, quadrate, thick-walled cells; *spores smooth or irregularly wrinkled, 31–36 μ in diameter;* calyptra 4–6 mm. long, yellowish, smooth or somewhat roughened above, *base fringed and lacerated, the fringe somewhat spreading and composed of abruptly enlarged, oblong, hyaline cells bordering 1–7 rows of smaller quadrate cells forming the basal margin of the calyptra proper.* Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 200;* M. H. M. *pl. 37;* Hedwig, l. c; *Pl. 71B.*
EXSICCATI:—Holzinger, Musci Acro. Bor. Am. 213; Bartram, Mosses So. Ariz. 113 and 32; Allen, Mosses Cascade Mts. 45; Musci Leibergiana 160 (in part); Austin, Musci Appal. 174; Macoun, Can. Musci 132, Can. Mosses 72a; Leiberg 364, 369, 786, 789, 580, 1165, 1364, 1402, 1581 and 1682. Drumm. Musc. Am. 50; Sull. & Lesq. Musc. Bor. Am. (Ed 1.) 111, (Ed. 2) 165.
This is one of the commonest species, Northern U. S. and Canada across the continent. It is not likely to be confused with anything else. The presence of the peristome and the fringed calyptra make it possible to identify the plant in the field.

4a. Var. MICROSTOMA Schimp. Coroll. Bry. Eur. 38. 1855.

"Seta only 3–6 mm. long; calyptra with brown fringe; capsule narrowing to the mouth, neck somewhat longer and tapering into the seta, peristome smaller, irregular, often lacking, spores very finely papillose, less transparent, and the radiating lines less distinct; ripe in August." (Coker, Bull. Torr. Club. **45**: 442.) Northern New York and alpine regions of the Rocky Mountains.

No specimens of this variety were available for study and the plant is included on the authority of other authors.

5. ENCALYPTA APOPHYSATA Nees & Hornsch. Bryol. Germ. **2**: 49. 1827.

Encalypta Macounii Aust. Bot. Gaz. **2**: 97. 1877.
Encalypta leiocarpa Kindb. Bull. Torrey Club **17**: 273. 1890.

Plants in tufts, 1–2 cm. high, brownish below, green above, stems short, slightly branched, leaves dense, crisped when dry, patent when moist, oblong to spathulate, 3–5 mm. long, strongly canaliculate, apex

rounded or bluntly pointed, a few acute; costa stout and disappearing below the apex, rarely percurrent or shortly excurrent, strongly papillose at the back near the base; *margin revolute, especially above;* upper median cells rounded to hexagonal, 10–15 μ, papillae 2–5 per cell, mostly low and simple; basal cells elongated, oblong, up to 12–17 μ wide and 47 μ long, *strongly papillose* with long simple or forked papillae; marginal basal cells becoming linear and thick-walled, suddenly shortened above so that there is a partial border of quadrate cells. Monoicous; perigonial leaves short, 0.8 mm. long, base long, somewhat clasping, narrowed above, acute or blunt; perichaetial leaves much like those of the stem but more pointed; setae 0.7–1.4 cm. long, yellowish to red, twisted when dry, capsules 3–4 mm. long without lid, *narrowly cylindric, neck long, either tapering to the seta or somewhat inflated and abruptly contracted, smooth or minutely wrinkled, slightly contracted under the mouth when dry, stomatous throughout;* walls of the exothecial cells thin, yellowish to brown except for 3–7 rows of short, thick-walled, reddish cells bordering the mouth; lid conic, long beaked, 1.5 mm. long; annulus double or triple; *peristome indistinctly double, teeth very slender, red, linear, split to the base or more often perforate along the medial line,* 0.4–0.6 mm. long, rather deeply inserted in the mouth, 12–14 jointed, finely and densely papillose, often with a pale papillose outer border; *endostome partially adhering to the teeth and often hidden by them,* usually paler but sometimes the same color as the teeth, often imperfect and adhering to the teeth here and there suggesting a preperistome; spores ovoid to round, *finely papillose, 21–30 μ;* calyptra reaching the base of the capsule or extending below it, 5–7 mm. long, beak usually very slender, minutely scabrous from tip to base, *fringe fugaceous, when present lacerated, cells abruptly differentiated, oblong, thin-walled and hyaline.* Type locality, Swiss Alps.

Illustrations:—Coker, Bull. Torr. Club **45**: 443, *pl. 14-A;* Limpricht, Laubm. **2**: 118, *fig. 247; Pl. 70A.*
Exsiccati:—Macoun, Can. Mosses 85 (as *E. longipes*): MacFadden 901 and 904 (as *E. vulgaris*).
Rocky Mts., Montana and northwards.

The slender smooth capsules with a bright red fringe of hair-like teeth make it almost possible to identify this moss on sight. The peristome may appear to be single at first, but closer observation will reveal the endostome which may be represented merely by a pale or hyaline membrane with pale segments wholly or partially adhering to the teeth, or, the endostome may be more strongly developed and more highly colored, the segments nearly as wide as the teeth and nearly as long. The former type of peristome is represented in Macoun's Canadian Musci 85 while Mrs. MacFadden's magnificent plants represent the moss at its best. The very strongly papillose basal cells of the leaves are distinctive. The spores are apparently larger than those described by most authors, Miss Coker gives 18–24 μ, Limpricht gives 21–26 μ while the plants I have seen show them to reach 30 μ.

Encalypta macounii Aust. is included as a synonym on the basis of the findings of Miss Coker, l. c. and *E. leiocarpa* Kindb. seems to have been established on false premises. (See also Mrs. Britton's article in Bull. Torr. Club **22**: 452–458. 1895.)

6. Encalypta brevicolla (Bry. Eur.) Bruch; C. Mull. Syn. **1**: 519. 1849.

Encalypta longicolla var. *brevicolla* Bry. Eur. fasc. 4, *pl. 202β.* 1838.
Encalypta labradorica Kindb. Eur. & N. Amer. Bryin. **2**: 295. 1897.
Encalypta subbrevicolla Kindb. Eur. & N. Amer. Bryin. **2**: 295. 1897.

Plants in tufts, stems 1–1.5 cm. high, simple or slightly branched; leaves 3–5 mm. long, *oblong to ovate, subacuminate, tapering to a point,* carinate; costa stout below, tapering to a point, *excurrent to a short or long hair point, smooth or spinulose;* margins plane; upper median cells quadrate to irregular 12–18 μ, papillae simple or lunate; basal cells oblong, hyaline or colored, 40–48 μ long and about 16 μ wide, marginal basal cells linear, thick-walled, smooth, colorless. Monoicous; perichaetial leaves slightly shorter and broader; seta about 1 cm. long, smooth and red; capsules cylindric, 3–4 mm. long, smooth when dry, exothecial cells thin-walled, stomata in the neck region; mouth bordered by 4–5 rows of small, thick-walled, red, quadrate cells; peristome double, deeply inserted; teeth 0.8 mm. long, irregularly broken and branched, usually united in pairs at the base and perforate above, papillose; inner peristome similar and attached to the outer, median segments longer than the lateral ones; lid conic, long beaked, 2–2.25 mm. long, with a red border; spores 28–32 μ, very rough; calyptra 5 mm. long, very scabrous at the apex, papillose over the entire surface, lacerate at the base. Type locality, European.

Illustrations:—Coker, Bull. Torr. Club **45**: 444, *pl. 14-B;* Bry. Eur. *pl. 202,* β. 1838, Suppl. *pl. 637; Pl. 70B.*
Exsiccati:—none.

This plant has been reported from Labrador and the East Coast of Greenland. Authentic American specimens were not available for observation and the above description was drawn partly from European exsiccati and partly from other authors.

7. ENCALPYTA PROCERA Bruch, Abh. Akad. Münch. **1**: 283, 1832.

Encalypta longipes Mitt. Jour. Linn. Soc. **8**: 29. 1865.
Encalypta Selwyni Aust. Bot. Gaz. **2**: 109. 1877.
Leersia procera Lindb. Musci Scand. 20. 1879.
Leersia Selwyni E. G. Brit. Bull. Torr. Club **18**: 50. 1891.
Encalypta cucullata C. Mull. & Kindb.; Macoun, Cat. Can. Pl. **6**: 96, in part. 1892.

Plants large, densely tufted, 1–5 cm. high; stems branched, triangular in cross section, *central strand composed of thin-walled smaller cells evident in most plants*, reddish radiculose below, green above; leaves patent to recurved, often nearly erect, slightly crisped or not much changed when dry, ovate-oblong to spatulate, 4–5 mm. long, concave to nearly flat, often clasping at the base; apex plane or cucullate, broadly rounded and obtuse or mucronate to long piliferous, hair usually hyaline, smooth or dentate; costa stout and prominent at back, red, strongly papillose throughout or smooth in part, percurrent or ending below the apex; upper median leaf-cells quadrate to hexagonal or irregular, often somewhat in lines, 14–20 μ in diameter, papillae simple, forked or lunate; marginal cells with projecting papillae; basal cells oblong, 16–22 μ wide, 40–72 μ long, hyaline, the walls usually red, end walls heavily thickened; marginal basal cells linear, thick-walled, smooth or papillose, area of basal cells extending obliquely up the margin; brood bodies often abundant, especially in sterile plants. Autoicous; perichaetia terminal, leaves much like those of the stem except the apex is more narrowed or with a longer hair point; perigonia borne just below the perichaetia, axillary, leaves with broader and more clasping bases, the inner ones with a much shorter upper lamina and shorter points, outer ones with longer points; vaginule 1–1.8 mm. long, seta 1.2 cm. long, yellowish-brown, red at the base and at the base of the urn, straight or twisted when dry; capsules cylindric, 3.3–6 mm. long, yellowish-brown, red at the mouth and base, spirally furrowed when dry, occasionally nearly smooth, neck short; stomata few, mainly in the neck region; mouth bordered by 2–3 rows of smaller quadrate, red cells; lid long rostrate, often 2 mm. long, rather stout; annulus large, double; peristome large, double, arising at or slightly below the mouth, teeth narrowly lanceolate or linear, 0.6–1.2 mm. long, united at the base, irregularly barred and perforate below, split above, strongly papillose, red; inner peristome from a yellowish basal membrane, segments narrowly lanceolate to linear, slightly keeled, nearly as long as the teeth or shorter, cilia linear, shorter than the segments, occasionally as long, papillose; spores smooth to granular, often wrinkled, 16–18 μ in diameter; calyptra large, cylindric, often long and narrow, yellowish, beak tapering or clavate, 6–10 mm. long, smooth or slightly scabrous, base pale, fringed, straight, seldom incurved. *Brood bodies often abundant, especially in sterile plants.* Type locality in Europe.

ILLUSTRATIONS:—Coker, Bull. Torr. Club **45**: *pl. 14-C*, Bruch, l. c., *pl. 2;* Bryol. Eur. *pl. 205;* Mitten, l. c., *pl. 5*, as *E. longipes; Pl. 72.*

EXSICCATI:—Holz., Musci Acro. Bor. Am. et Eur. 615; and 614 (as *E. contorta*); Grout, N. A. Musci Perf. 107; Macoun, Can. Musci 371 & 565, 134 (as *E. Selwyni*), 370 & 470 (as *E. longipes*), 371 & 374 (as *E. cucullata*); Macoun, Can. Mosses 76a & 75a (as *E. cucullata*); 374 & 491 (in part as *E. cucullata*); Musci Leibergiana 166 (as *E. Selwyni*); Kaiser, Bry. So. & Cent. British Col. 782; Leiberg, 795, 796 & 799 (as *E. Selwyni*); Drumm., Musci Am. 48 (as *E. streptocarpa*).

On wet or damp soil and in crevices of rocks. Alaska to Montana, Idaho and Washington. Common in British Columbia. Also in Ontario, Greenland, Northern Europe and Asia.

This plant is subject to variations according to the habitat. In damp or rather dry places it is shorter, the leaves mostly incurved when dry, and only slightly crisped. In wet situations it often becomes much elongated with distinct junctions of seasonal growth, the lower portion being slender, the leaves more or less appressed, while the upper portion has a tuft of leaves closely inserted, patent to recurved. Very often the base of the leaf is little changed in drying while the upper lamina is crisped. In general the lower leaves are distant and longer. *E. streptocarpa* occasionally has distant leaves. As is usual in most mosses the upper leaves have narrower apices than the lower ones. Plants with extremely blunt leaves show this to a less degree than those with hair points. Some hair points of the upper leaves have been observed to exceed two millimeters in length. In many plants with very broadly rounded leaves the upper leaves are also rounded or obtuse, but a few have been seen where the upper leaves have short hyaline hair points. The degree of concaveness also varies, some leaves are nearly flat but most are strongly concave or cucullate. The area of oblong, colored basal cells may be very short, scarcely clasping, but in most plants it is longer, up to one third the length of the lamina and of bright red color, often forming an abrupt oblique junction with the green chlorophyllose cells of the upper lamina. The bases of many leaves are fragmented due to the breaking of the thin lateral walls of the basal cells. The costa is yellowish when young but becomes red with age. It is very prominent at the back, especially when dry, and most frequently is densely papillose, but exceptions have been noted where it is nearly smooth or extremely scabrous. The brood bodies are often abundant, especially on sterile plants. They arise from the stems and leaf-bases as rhizoid-like

outgrowths which branch dichotomously forming dense clusters of red, parallel branches. The lower portion is usually slender and increases in diameter above, the tips ultimately forming the closely separate brood bodies which consist of two to eight cells with thick walls and dense cellular contents. Cross sections of the stem have been found to show a central strand in most plants, a character which serves to separate sterile plants from *E. streptocarpa* which very seldom shows any trace of a central strand.

8. Encalypta streptocarpa Hedw., Sp. Musc. 62. 1801.

Encalypta contorta (Wulf:) Linb. Oefv. Sv. Vet-Akad. Forh. **20**: 396. 1863.
Leersia contorta Lindb. Musci Scand. 19. 1879.

Plants large, in loose or dense tufts; stems 2–5 cm. high, branched, triangular in cross section and *without a central strand or only a slight suggestion of one*, brownish below, with red rhizoids, green above; leaves strongly crisped when dry, often infolded and incurved, patent to imbricated when moist, ligulate to oblong spatulate, 3–5 mm. long, concave, often cucullate; apex broadly rounded, obtuse or bluntly mucronate, *never hair pointed;* base often narrowed; costa stout, prominent at the back, percurrent or ending below the apex, strongly papillose throughout or in part, often toothed at back above; margins plane; upper median cells quadrate to rounded or hexagonal, 10–16 μ in diameter, papillae simple, forked or lunate, basal cells usually reddish, oblong, up to 18 μ wide and 60 μ long, smooth, end walls heavily thickened; marginal basal cells linear, thick-walled; base often much broken in older leaves; brood bodies arising from the leaf bases and stem as rhizoid-like outgrowths which branch repeatedly forming sheafs of multiseptate bodies at the tips; cells quadrate, thick-walled, papillose and red. Dioicous; perigonia terminal, leaves ovate to oblong, subacuminate, tapering to a sharp or blunt point, the inner ones clasping; perichaetia terminal, leaves much like those of the stem, apex more tapering, blunt or subacute; vaginule 1–1.4 mm. long; seta reddish, 1–1.7 cm. long, straight or flexuose; capsule cylindric, 3–4.4 mm. long (mouth to base), spirally furrowed when dry; mouth bordered by 2–3 rows of quadrate, reddish, thick-walled cells; exothecial cells usually in several rows of thick walled cells alternating with several rows of thin walled cells, stomata in the neck region; *peristome double, teeth very long and narrow*, entire, perforate or split into *long filamentous divisions, more or less united at the base by trabeculae*, reddish, finely and densely papillose, 0.8–1.4 mm. long; inner peristome forming a thin basal membrane, pale or yellowish, *segments split into 32 slender strongly jointed, pale, papillose cilia, often adhering to the teeth and difficult to observe; spores small, 8–12 μ in diameter*, greenish or yellowish, smooth; lid, conic, long beaked, 1.5 mm. long; annulus large, double; calyptra large, 6–10 mm. long, reaching below the base of the capsule, beak scabrous, smooth below or faintly scabrous; cells slightly oblique, base fringed, lacerate, cells not abruptly differentiated, becoming slightly larger, hyaline. Type locality, European.

Illustrations:—Coker, Bull. Torr. Club **45**: 445, *pl. 14D;* Bruch & Schimp., Bry. Eur. *pl. 204;* M. H. M. 170, *f. 80; Pl. 70A.*

Exsiccati:—Holzinger, Musci Acro. Bor. Am. 141; Sull. Musci Allegh. 152; Austin, Musci Appal. 175; Macoun, Can. Musci 86, 135 & 373.

Plants growing in the crevices of wet rocks, usually containing lime and on soil. It is essentially eastern ranging from North Carolina to Labrador, west to Iowa and northward to British Columbia. Thus far, it has not been found fruiting in North America. Holzinger's 614 is undoubtedly *E. procera* in spite of the fact that it may have been demonstrated to be dioicous. I found it very difficult to separate *E. streptocarpa* and *E. procera* with muticous leaves in the sterile condition. This led to a careful investigation of the gametophyte structures which resulted in the discovery of a central strand in the stem of *E. procera*. In contrast *E. streptocarpa* was found to have no strand or at best only a slight suggestion of one due to the convergence of the cells at the center. In either case very few exceptions were noted and European plants bear out the conclusions. In sectioning stems the older portions should be used. The capsules and peristome characteristics shown in the illustrations were taken from European plants. The majority of the leaves of American specimens are broadly rounded or cucullate. The bases of the leaves frequently fragment due to the breaking of the thin lateral walls.

Key to Sterile Specimens of Encalypta.

A. J. Grout.

As the genus is so difficult that often perfect plants are difficult of determination, it must be thoroughly understood that this attempted key is mainly suggestive. Final determination must depend on a careful comparison of the plant with the description and illustration.

1. Leaves muticous	2.
Some or all of the leaves aristate	5.
2. Basal cells of leaves strongly papillose	*5. apophysata.*
Basal leaf cells smooth or nearly so	3.
3. Central strand present in the stem	4.
Central strand lacking. (The most common species east of the Rockies.)	*8. streptocarpa.*
4. Costa ending well below the apex	*2b.* var. *mutica.*
Costa percurrent, usually excurrent or piliferous in mature plants	*7. procera.*
5. Leaf margins plane; known in N. America from Labrador and Greenland only	*6. brevicolla.*
Leaf margins various, recurved or incurved in some cases	6.
6. Area of elongate basal cells extending obliquely up the leaf margin, more or less papillose	*7. procera.*
Area of elongate basal cells not extending obliquely up the margin, all smooth	7.
7. Leaf base very concave-clasping, often tube-like and expanding into shoulders at the junction with the squarrose upper lamina	*1. alpina.*
Leaves not as above in all particulars	8.
8. Leaf base plane or incurved; most leaf apices piliferous, often longly so	*3. rhabdocarpa.*
Leaf base often recurved; leaves, except the perichaetial, merely apiculate in most cases.	9.
9. Leaf apex never piliferous, upper margins plane	*4. ciliata.*
Leaf apex sometimes piliferous in upper leaves, upper margins incurved and leaves often cucullate	*2. vulgaris.*

BUXBAUMIACEAE

Plants with exceedingly short stems and a more or less persistent protonema; leaves small and vanishing or larger and resembling those of the Pottieae; capsules nearly sessile or on a moderately long rough seta, oblique, unsymmetric, more or less ventricose dorso-ventrally; calyptra very small, conical; peristome single or double, the outer, when present, of one to several concentric rows of slender teeth, more or less segmented; the inner a 16-plicate membrane, open at the top for spore dispersal.

Key

Leaves vanishing before the capsules mature; seta rough, as long as, or longer than the capsule	*1. Buxbaumia.*
Leaves persistent, pottioid; capsules almost sessile in bristle-bordered perichaetial leaves	*2. Diphyscium.*

BUXBAUMIA (Hall.) Hedw. Sp. Musc. 166. 1801.

Plants very small, annual, scattered, the archegonial with a short (1 mm.) stem, bearing a few small vanishing leaves, ovate to ovate-lanceolate, palmate with cilia-like projections of the marginal cells, ecostate and without chlorophyll except at base. Dioicous; male plants minute, the few leaves not ciliate, antheridia 1–2, subglobose. Seta 5–20 mm. long, thick, red-brown, rough; capsule obliquely ascending, dorso-ventrally unsymmetric, ovoid to oblong-ovoid, tapering to a very small mouth; peristome as described above; spore sac small, surrounded by a relatively large air-space; annulus (or preperistome) of several rows of cells.

Key.

1. Capsules little longer than broad	3.
Capsules at least twice as long as broad	2.
2. Capsules ovoid, yellow with age; spores up to 11 μ	*3. Piperi.*
Capsules lance-cylindric, dark brown; spores 12 μ	*4. subcylindrica.*
3. Capsules little flattened dorsally, paler often yellowish; stomata 2-celled, superficial.	*2. indusiata.*
Capsules much flattened dorsally, plano-convex; stomata 1-celled, immersed	*1. aphylla.*

1. Buxbaumia aphylla [L.] Hedw. Sp. Musc. 166. 1801.

Seta erect, about 1 cm. long, very rough; capsule inclined to almost horizontal, with a distinct stout neck, chestnut-colored, ovoid-acuminate, *flattened above and angular at the edges, 5–7 mm. long and nearly as*

broad, the cuticle rolling back from the mouth after dehiscence; operculum short, obtusely conic; outer peristome of a single series of short, slender, papillose teeth; inner membrane pale brown; spores 5–7 μ, mature late autumn to spring. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 427, 428b;* Braithw., Brit. Moss. Fl. **1:** *pl. 3A;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 7C;* Jennings, Mosses Western Pa. *pl. 20;* M. H. M. *f. 19* & *pl. 8;* Mosses w. H.-lens *f. 14; Pl. 73a.*

EXSICCATI:—Aust. Musc. Appal. 242; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 222, (Ed. 2) 331; Holz. Musc. Acro. Bor. Am. 250.

On humus, rarely on decaying wood in moist shaded places across the continent from Canada and W. Virginia to Washington; widely distributed but local. Occasionally it may be found in the same locality for successive seasons but oftener not. Mice will eat the capsules as I have direct evidence, probably insects also. This may account for the eccentricities of its appearance.

2. BUXBAUMIA INDUSIATA Brid. Bryol. Univ. **1:** 331. 1826.

Differs from the more common *B. aphylla;* capsule more erect, less flattened dorsally, lighter colored, cuticle thinner, ultimately splitting longitudinally with edges rolled backward; outer peristome of four concentric rows of linear, jointed papillose teeth, the outermost very short, the others increasing in length to the innermost, which is about ½ the length of the inner cone; spores 8–12 μ, mature in summer. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 428* Braithw. Brit. Moss. Fl. **1:** *pl. 3B;* M. H. M. *pl. 8.*

Principally on decayed wood. Rare; Nova Scotia, Montana, Washington. In appearance grades into *Piperi,* which is typically much larger.

3. BUXBAUMIA PIPERI Best, Bull. Torr. Club **20:** 116. 1893.

Seta arcuate or flexuose; capsule brown, *becoming yellow with age, ovate-oblong, 2–2.5 : 1, broadly elliptic in section;* outer peristome with a single row of filaments and rudiments of a second; other characters much as in *B. aphylla* except that the capsule is less flattened dorsally in the specimens examined; spores 7–11 μ. Type locality, Washington.

ILLUSTRATIONS:—Bull. N. Y. Bot. Gard. **2:** *pl. 39; Pl. 73A.*

On rotten wood or humus; Washington, Idaho, Montana; British Columbia.

While resembling *B. aphylla* in many respects, the capsule is rarely, if ever, so dark and often becomes bright yellow with age and is more elongate and less flattened when dry. The following notes are by R. S. Williams.

"The large columella is adnate to the base of the sporangium and appears to stop abruptly with a short beak just below the mouth of the capsule, as does also the sporangium. The lid when mature, separates at its base from the capsule but remains attached to the peristome by a central axis. When this axis is separated from the peristome it leaves a small circular opening at the apex of the peristome, from which, on pressure of the capsule the spores fly out. . . . The primary outer peristome is made up of nearly linear, rather irregular teeth, more or less adhering together and about the length of the inner peristome At the base of the primary peristome are a few irregular and much shorter teeth, mostly rudimentary and sometimes in two rows, more or less. The teeth seem to be mostly quite flat or with margins incurved and I do not see that the inner peristome ever splits into proper segments."

4. BUXBAUMIA SUBCYLINDRICA **n. sp.**

Buxbaumia indusiata of American authors only.

Ab speciebus praecedentibus ita differt; capsula elongata, lanceolata-cylindracea, ad dorsum non complanata, minime ventricosa; peristomii dentes externi minimi; sporae ± 12 μ.

Distinguished from the two preceding species by the elongated lance-cylindric capsule, not flattened dorsally, very little wider than deep and only very slightly ventricose; outer peristome teeth rudimentary and difficult to demonstrate; operculum sharply conic; stomata obscure, at the junction of capsule and seta; spores about 12 μ, mature in October and later. Type locality, Climax, Michigan.

ILLUSTRATIONS:—Mosses w. H.-lens, *f. 14; Pl. 73b.*

On rotten wood in moist shaded places; New England to British Columbia, south to Ithaca, N. Y.

The outer walls of the capsules are very firm and show none of the tendency to peel that is characteristic of *B. indusiata* Brid. I have been unable to find stomata or outer peristome, but R. S. Williams states that he found the stomata but could not tell whether they were superficial or immersed. Dr. Wm. C. Steere says rudiments of an outer peristome may be seen by looking down vertically upon the deoperculate capsule.

DIPHYSCIUM [Ehrh. 1787] Mohr, Obs. Bot. 34. 1803.

Sporophyte resembling *Buxbaumia*, but very different as to gametophyte. We have one species.

DIPHYSCIUM FOLIOSUM (Hedw.) Mohr, Obs. Bot. 34. 1803.

Buxbaumia foliosa Hedw. Sp. Musc. 166. 1801.
Webera sessilis Lindb. Oefv. Vet. Akad. Foerh. **20**: 394. 1863, and **21**: 576. 1864.

Plants densely gregarious in wide dark green mats; stems very short; *leaves lingulate, mostly obtuse, sometimes somewhat cucullate, crisped when dry, of two or more layers of cells*, 3–4 mm. long, obscure, papillose on both sides; margins plane, crenulate-papillose and often somewhat irregular above; costa vanishing below the apex, broad and flattened, especially at the base, *in cross section without guides in the upper part;* upper leaf cells rounded-quadrate to hexagonal, small, ± 12 μ in diameter, rectangular, hyaline and smooth at the base; perichaetial leaves large, ovate-lanceolate, the inner membranous, *whitish, at apex lacerate-ciliate, long-aristate by the rough excurrent costa.* Dioicous; capsule almost sessile, immersed, brown, strongly unsymmetric, conic-ovoid and ventricose, inclined; conical operculum uptilted, annulus small, outer peristome lacking, inner a truncate whitish cone, 16-plicate, thickened and papillose on the ridges; spores minute, about 8–10 μ, mature early summer. Male plants minute, scattered. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. 428; Braithw. Brit. Moss Fl. **1**: *pl. 42;* Dixon, Handb. Brit. Mosses, (Ed. 3) 7D; M. H. M. *f. 20, pl. 8;* Mosses w. H.-lens, *f. 16;* Broth. Naturl. Pflanzenf. (Ed. 2) **11**: *f. 771.*
EXSICCATI:—Drumm. Musc. Am. S. States 74; Aust. Musc. Appal. 240, 241; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 223, (Ed. 2) 332; R. & C. Musc. Am. Sept. 184; Grout, Musci Perf. 64; Holz. Musc. Acro. Bor. Am. 121, and 331 as *Gyroweisia tenuis.*
On shaded banks; common east of the Rocky Mts., south to Alabama.
The leaves of sterile plants so strongly resemble those of some of the *Pottiaceae* that others besides Holzinger have been deceived. A cross-section of the costa will usually serve to identify them.

Family POTTIACEAE

Plants small to large, mostly in sods or tufts; stems radiculose at base only, mostly with central strand, densely foliate, simple or with branching dichotomous or fasciculate; leaves several ranked, various in form; costa strong and usually of heterogeneous cells; leaf cells usually thin-walled and hyaline at base, the upper usually small, thick-walled and more or less papillose, often strongly so, and obscure. Cleistocarpous, gymnostomous, or usually peristomate; capsules in a few genera immersed but in most long-exserted on a straight seta, usually erect and symmetric or nearly so; peristome when present of 16 teeth, straight or spirally twisted, from a basal membrane and often divided into 32 filiform papillose divisions; operculum usually conic-rostrate; calyptra cucullate.

A large and polymorphous family, difficult to define satisfactorily by reason of the degenerate sporophytes of some of its genera.

1. Male and female flowers axillary or cladocarpous ..... 2.
   Acrocarpous, sporophyte terminal or lateral by innovations (except *Pleurochaete*) . 3.
2. Flowers axillary; capsule long-exserted; peristome lacking ..... *1. Pleuroweisieae.*
   Flowers on a short lateral branch; capsules merely emergent, without air space or stomata; peristome present ..... *4. Cinclidoteae.*
3. Leaves narrowly lanceolate to oblong (exceptions in *Hyophila, Barbula* and ?); costa with two stereid bands (except *Leptodontium*) ..... *2. Trichostomeae.*
   Leaves broadly ovate or oblong, lingulate or spatulate (with few exceptions); costa with dorsal stereid band only ..... *3. Pottieae.*

Leptobarbula berica (DeNot.) Schimp. has not yet been found in North America. Macoun's specimens so named were *Ditrichum pusillum* (Hedw.) E. G. Britton.

PLEUROWEISIEAE

*ANOECTANGIUM Schwaegr. Suppl. 1[1]: 33. 1811, emend.

Plants short or tall, slender, branching, densely matted in most cases; central strand of stems weak or lacking; leaves erect-spreading, appressed when dry, not secund, contorted but rarely crisped, lanceolate to

* See p. 192.

narrowly oblong, densely papillose; costa ending below the apex or rarely shortly excurrent, in cross section with median stereid band only, or with ventral guides and only a dorsal stereid band, or with median guides and a weak ventral stereid band which often disappears in the basal portion; upper leaf cells obscure, papillose; basal cells elongated, narrowly rectangular, usually smooth and transparent; perichaetium lateral. Seta long; calyptra smooth, cucullate; capsules oblong to obovate; operculum usually obliquely long-rostrate; peristome lacking. Type species, *A. compactum*.

The lateral sporophyte and the leaf structure closely resemble some of the *Orthotrichaceae*. Sterile plants are most likely to be sought in *Zygodon* or *Amphidium*. *Leptodontium* and *Gymnostomum* seem to be its nearest allies in the *Pottiaceae*.

KEY.

1. Leaves oblong, little narrowed until the apex ..... 4.
   Leaves lanceolate, gradually narrowed ..... 2.
2. Fully developed leaves 1.5 mm. long or less, acute ..... 3.
   Fully developed leaves over 2 mm. long, narrowly subulate at apex ..... *2. Peckii.*
3. Costa with ventral guides and a single dorsal stereid band throughout ..... *1. compactum.*
   Costa with median guides and two stereid bands, the dorsal very small at base
   4. Sendtneri var. *tenuinerve* f. *arctica.*
4. Leaves apiculate ..... *3. euchloron.*
   Leaves rounded-obtuse at apex ..... *5. obtusifolium.*

1. ANOECTANGIUM COMPACTUM Schwaegr. Suppl. **1**[1]: 36. *pl. 11.* 1811.

Zygodon compactus C. Muell. Syn. **1**: 683. 1849.
Gymnostomum aestivum Hedw. Sp. Musc. 32. *pl. 2, figs. 4–7.* 1801 (doubtfully a synonym; see Limpr. Laubm. **1**: 246).
Anoectangium aestivum Bry. Eur. fasc. 29–30. *pl. 37.* 1846.

Plants in deep dense tufts, bright green at the surface, brown and tomentose below; stems slender, brittle, 2–10 cm. long; leaves erect-spreading from an erect base, contorted and incurved when dry, lanceolate to linear-lanceolate, gradually acuminate and acute, less than 2 mm. long, strongly keeled; margin plane, minutely crenulate with papillae and sometimes irregular in outline above; costa strong, more or less papillose at back, subpercurrent, largely on the dorsal side of leaf, in cross section with a large central stereid band surrounded dorsally and ventrally by a single row of large cells; upper leaf cells small, 6–8 μ, with 2 or more papillae on each surface, except at extreme apex, rounded-quadrate, obscure; basal cells short-rectangular, up to 10 μ, less obscure; perichaetial leaves sheathing at base, not papillose, the upper larger. Dioicous; seta 6–12 mm. long; capsule obovoid, *with a short neck*, smooth, reddish, wider at the mouth when dry and empty; annulus indistinct; operculum obliquely long-rostrate; spores 10–14 μ. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. l. c.; Limpr. Laubm. **1**: 245, *f. 92;* Braithw. Brit. Moss Fl. **2**: *pl. 54A;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 31D; Pl. 74.*

On noncalcareous rocks, arctic-alpine; Alaska, Greenland.

In all the specimens examined the cells are more obscure than in *A. Peckii*. A specimen near Pueblo, Mexico, Bro. Arséne no. 4800, det. as *A. compactum* by Thériot has most capsules curved and unsymmetric with a longer neck; plants about 4 cm. long. The leaves are shorter and less slender pointed than is usual in *A. Peckii*, yet it may possibly be better referred to that species.

2. ANOECTANGIUM PECKII Sull. in Aust. Musc. Appal. 64. 1870; Icones Musc. Suppl. *pl. 25.* 1874.

Perhaps better regarded as a regional variety of the last; differing in the longer leaves, often more than 2 cm. long, more slenderly and abruptly subulate-apiculate, leaf cells less obscure. Sporophyte unknown. Type locality, under overhanging rocks, Catskill Mts., N. Y. Also in the Great Smokies in Tennessee, by A. J. Sharp (Verdoorn, Musci Selecti et Critici 107; Grout, Musci Perf. 254).

Besides the larger size, the rather abrupt narrowing to a short slender point is the most conspicuous difference between this and the last. *Pl. 74.*

3. ANOECTANGIUM EUCHLORON (Schwaegr.) Mitt. Jour. Linn. Soc. **12**: 176. 1869.

Gymnostomum euchloron Schwaegr. **2**[2]: 83. *pl. 176.* 1827.
Anoectangium Breutelianum Bry. Eur. fasc. 29–30. 1846 (nomen nudum).
Gymnostomum guadalupense Spreng. Syst. Veg. **4**[1]: 145.
Gymnostomum lamprocarpum Mont. Ann. Soc. Nat. **1838**: 49. 1838.
Zygodon pusillus C. Muell. Syn. **1**: 684. 1849.
Zygodon tenellus Mitt. Jour. Bot. **1851**: 56. 1851.

Loosely cespitose, bright green above; leaves oblong, subobtuse or apiculate, often finely denticulate at apex, crisped when dry, larger above, reaching 1 mm. or more in length; costa rough on the back; leaf cells about as in *A. Peckii* and about the same size, the basal rather shorter; perichaetial leaves rather abruptly acuminate, the inner occasionally rounded-obtuse.

Seta straight, 3–4 mm. long; capsules oblong-obovoid, including the tapering neck about 1 mm. long; operculum long-rostrate; calyptra cucullate, beaked; spores about 12 μ in diameter, mature in autumn. Type locality, West Indies.

ILLUSTRATIONS:—Brotherus in Engler & Prantl, Musci (Ed. 2) 245, *f. 201; Pl. 73.*
Moist bluff, Dry Falls, Macon Co., N. Carolina, alt. 3700 ft. (*A. J. Sharp*, no. 3718). Common in Mexico and Central America; also found in West Indies, South America, Hawaii and India.

4. ANOECTANGIUM SENDTNERIANUM Bry. Eur. fasc. 29–30. *pl. 39.* 1846.

Var. TENUINERVE (Limpr.) Moenk. Laubm. Europas, 257. 1927.

Molendoa tenuinervis Limpr. Laubm. **1**: 250. *f. 95.* 1886.

Plants densely cespitose, brownish green, up to 3 cm. long, easily separating, brittle, very slender; stems with central strand, uniformly and densely foliate; leaves loosely appressed with incurved apices when dry, erect-spreading when moist, from an ovate or oblong base rather abruptly narrowed to a lanceolate upper portion, obtusely acute, 0.34–0.6 mm. wide in the basal portion and ± 1 mm. long; margins plane, entire; costa strong, ending below the apex, in cross section showing a single row of guides and a dorsal and ventral stereid band, the latter sometimes weak or lacking, especially at the base; basal cells unistratose, smooth or rarely with a few papillae, irregularly rectangular, 1 : 2–1 : 4, the upper bistratose, strongly papillose on both faces irregularly polygonal, triangular or subquadrate, 7–10 μ in diameter, sometimes larger. Dioicous, archegonial and antheridial buds axillary; sporophytes unknown. Type locality, Windischmatrei, Tyrol.

ILLUSTRATIONS:—Limpr. l. c.; Györfy, Bryol. **15**: *pl. 3.* 1912; *Pl. 75.*
The North American forms from the arctic were described as *Gymnostomum laeve* by Bryhn in The Report of the Second Norwegian Expedition in the "Fram," no. 11. 1907.*
Györfy in the Bryologist, l. c. describes the arctic plants from King Oscar Land minutely and considers them a form of *Molendoa tenuinervis.*
One form† he calls forma *ARCTICA* differing from other forms of *M. tenuinervis* in the shape of the leaves, with fewer papillae, lamina entirely bistratose in the upper part, leaves smaller. Another form‡ with shorter and broader leaves, scale-like and lightly attached, with more numerous papillae he names forma *XEROPHILA*. The most striking difference from Limpricht's type seems to be the two well developed sterid bands as shown in *Pl. 75*. Similar plants were found in neighboring localities. Plants from Ellesmere Land have been seen.

5. ANOECTANGIUM OBTUSIFOLIUM (Broth. & Par.) **n. comb.**

Molendoa obtusifolia Broth. & Par. Rev. Bryol. **40**: 36. 1913.

Plants in wide thin mats, up to 5 mm. high, strongly resembling *Gymnostomum calcareum* in general appearance; leaves contorted when dry, when moist erect-spreading from an appressed base, linear-ligulate, more or less keeled, the upper larger, ± 1 mm. long, bistratose above in patches, sometimes all along the upper margins; margins plane, entire; costa stout, ending well below the apex, in cross section with median

* See the Bryologist, **11**: 80. 1908.
† Ex Herb. Bryhn, no. 3889.
‡ Ex Herb. Bryhn, no. 3884.

guides and a well developed dorsal stereid band, the ventral small, not extending its whole length at base; basal cells hyaline, smooth, rectangular, up to 39 μ or more in length near the costa, shorter at the margins, gradually merging into the obscure, rounded papillose upper cells, which are thick-walled and with lumen 5–7 μ in diameter; inner perichaetial leaves over 1 mm. long, sheathing at base, abruptly narrowed to a slender somewhat spreading upper portion, with cells larger, smooth and distinct. Archegonial and antheridial buds lateral in the axils of leaves; seta erect, about 5 mm. long; calyptra large; capsule ovoid, ± 1 mm. long, narrower at the mouth; annulus not apparent; operculum abruptly long rostrate, somewhat shorter than the urn; spores 7–9 μ; mature in autumn. *Pl. 75.* Type locality Mexico.

Santa Rita Mts., Santa Cruz Co., Arizona (*Bartram*); Texas (*Orcutt*); collected abundantly in Mexico by Bro. Arsène.

Some specimens collected by Bro. Arsène in Mexico det. Thériot, though very dense and obscure above, show in cross section only a single layer of densely papillose cells, nearly quadrate in outline except occasional bistratose patches near the margin. The costa near the base shows two rows of large cells on the ventral side and only a dorsal stereid band.

TRICHOSTOMEAE (Key p. 191)

1. ASCHISMA Lindb. Utkast. 28. 1878.

Phascum sp. Web. & Mohr, Taschenb. 69 & 450. 1807.

Distinguished from *Phascum* chiefly by having both dorsal and ventral stereid bands in the costa.

ASCHISMA KANSANUM Andrews, Torreya **15:** 63. 1915.

Plants gregarious from an abundant persistent protonema, up to 2 mm. high; leaves when dry subsecund, up to 1.5 mm. long, "from a long narrow clasping base of very thin-walled hyaline cells widening to well up near the apex, giving a rather spatulate or obovate effect to the leaf as a whole"; costa broad, up to 70 μ at base and 25 μ in the excurrent mucro, in section showing 4 entirely included guide cells with stereid bands both dorsally and ventrally; upper leaf cells thick-walled, roundish or irregular in shape, 7–10 μ in diameter, very strongly papillose on both surfaces with a single large papilla which may be irregular or slightly pronged at apex, leaving the cell walls very clearly defined; a border region about two cells wide, with cells about twice as long as wide and without papillae, begins near the apex and extends to the hyaline basal cells. Autoicous, the antheridia on a short inconspicuous lateral branch. Seta very short, about 0.08 mm. long to the oblong-cylindric vaginule 0.23 mm. long; capsule small, 0.4 mm. in diameter, deeply immersed, shining yellowish-brown, spherical with an inconspicuous apiculus; operculum lacking; the thin brittle epidermis composed, except at base and apex, of cells in a palisade-like arrangement, elongated-rectangular to hexagonal, up to 15 x 50 μ; spores light yellow, very slightly roughened, 15–20 μ in diameter. Type locality, "Prairies of western Kansas" (Hall). Type material in the herbarium of the New York Botanical Garden and the Sullivant and James Herbarium. (Description adapted from Dr. Andrews' original description.) *Pl. 83.*

On "flint pebbles in the Kansas prairies. It grows also a thick leathery confervoid stratum and is remarkable for affecting only flint pebbles or small flint rocks at their base." (Hall in a letter to Lesquereux.)

This is the *Phascum carniolicum* of the Lesq. & James Manual.

This European species differs from *A. kansanum*, according to Dr. Andrews, in the less conspicuous, more or less subterraneum protonema; plants shorter with shorter leaves; capsule larger in proportion and more exposed; the color is a more reddish brown; the spores are darker and more strongly papillose; leaves more crisped when dry, ovate-lanceolate; basal cells thinner-walled, the upper also thinner-walled, not differentiated at the border; papillae shorter, generally several (up to 4) on either surface; costa only about 40 μ wide at base, with normally only 2 included guides; ventral stereid band usually lacking.

2. ASTOMUM Hampe, Flora **20:** 285. 1837.

Small gregarious mosses growing on soil; stems simple or branching; upper leaves longer, tufted, 2–3 mm. long, crisped when dry, lanceolate, keeled, with incurved margins; upper leaf cells small, rounded-quadrate, papillose on both sides. Autoicous; capsules immersed, subglobose to oblong-ovoid, apiculate; operculum usually formed but not dehiscent; peristome none; calyptra cucullate, rarely mitrate, smooth.

Distinguished from *Bruchia* and *Pleuridium* by the crispate leaves, strongly papillose on both sides, from *Archidium* by its smaller and more numerous spores, and from *Phascum* and *Archidium* by the involute leaf margins and narrower leaves. Sterile plants are hard to distinguish from *Weisia viridula*.

KEY.

1. Leaf margins strongly involute; setae solitary ..... 2.
   Leaf margins mostly plane; setae often clustered ..... 3. *ludovicianum.*
2. Seta much shorter than the capsule ..... 1. *Muhlenbergianum.*
   Seta as long as the perichaetial leaves ..... 2. *phascoides.*

1. ASTOMUM MUHLENBERGIANUM (Sw.) n. comb.

Phascum Muhlenbergianum Sw. Adnot. Bot. 74. 1829.
Astomum Sullivantii Schimp. Bry. Eur. fasc. 43. 1850.
Hymenostomum Muhlenbergianum (Sw.) Andrews, Bryol. **25**: 67. 1922.

Densely cespitose; stems simple or sparsely branched above, ± 5 mm. high; leaves spreading, strongly crisped when dry, the lower usually much smaller, the upper and perichaetial, up to 3 mm. long, from a subsheathing base linear-lanceolate, strongly involute to subtubular above, entire; costa strong, excurrent into a short mucro; basal cells hyaline, rectangular, narrower near the margin, smooth; the upper quadrate to hexagonal, *7–12 μ*, pleuripapillate, dense. Seta very short, about the length of the vaginula, both together shorter than the capsule; capsule elongate-spherical, ± 0.4 mm. in diameter, apiculate; *spores 20–30 μ* in diameter, strongly papillose; mature in early spring. Type locality, eastern U. S., probably Pennsylvania.

Distinguished from *A. crispum* by leaf cells up to *12 μ*; upper and perichaetial leaves less slenderly pointed as a rule. Capsule lighter colored; spores larger, 20–39 μ (14–17 μ in *crispum*).

ILLUSTRATIONS:—Sull. Icones Musc. *pl. 11; Pl. 77.*

EXSICCATI:—Drumm. Musc. Am. 11, S. States 9; Sull. Musc. Allegh. 211 (both as *Phascum crispum*); Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 35, 36 (as *A. nitidulum*); (Ed. 2) 47; Aust. Musc. Appal. 58 (59 as var. seems more likely to be a form of *Weisia viridula*); Grout, Musci Perf. 213.

On soil in old fields; Saskatchewan to Massachusetts, south to Arizona, Texas, Louisiana, Alabama and probably the other Gulf States.

The distinction of the orange colored capsules for this species does not hold. Schimper describes it as smaller than *crispum* with smaller spores, which is not true of the general run as to size and never as to the spores.

Dr. A. LeRoy Andrews (Bryol. **25**: 66–71. 1922) states that in his opinion, after getting all the available information as to the type, *Astomum nitidulum* Schimp., type, is perhaps a hybrid between *A. Muhlenbergianum* and *Weisia viridula*, but that most of the plants referred to this species are aberrant forms of *Muhlenbergianum*. He also states that the drawings made from Schimper's specimens at Kew were made from plants collected at Easton, Pennsylvania, and not from the type locality in Ohio.

He further states that he does not think true *A. crispum* occurs in N. America, an opinion with which I concur.

Andrews also adds the following distinctions: in *Muhlenbergianum* the operculum is "never separated off," the exothecial walls are hardly more than 1–2 μ thick with usually a single layer of weak cells between the exothecium and the spore sac. In *crispum* the operculum is often distinctly differentiated, the exothecial wall 8–19 μ in thickness with several layers of fairly strong cells between it and the spore sac. Andrews had the privilege of seeing the type of Swartz from the Naturhistoriska Riksmuseum of Stockholm, presumably from Pennsylvania.

Andrews (l. c.) also states that American plants referred to *A. multicapsulare* Sm. are very large *A. Muhlenbergianum*, the size being due to a very moist habitat.

2. ASTOMUM PHASCOIDES (Hook.) n. comb.

Gymnostomum phascoides Hook. in Drumm. Musc. Am. no. 12. 1828 (the type); not *Hymenostomum phascoides* Wils. Bry. Eur. 1850.
Astomum Drummondii Kindb.; Macoun, Cat. Can. Pl. **6**: 12. 1892.

Leaves stouter than in the last, less slender at apex. Seta nearly as long as the perichaetial leaves; capsule rostrate, beak up to 0.4 mm. long; spores *20–25 μ*, reticulate-pitted. Type locality, Saskatchewan.

Often with the last or with *Weisia viridula*, which led Andrews to suspect it to be a hybrid. In a recent letter he is less inclined to this idea and states that the original *A. nitidulum* was in reality *A. phas-*

coides. It has been collected in Saskatchewan, Minnesota, Ohio and several localities in Arizona and Texas. This wide distribution makes it unlikely that it is a hybrid. *Pl. 84.*

3. Astomum ludovicianum Sull. Icones Musc. 21. *pl. 12.* 1864.

Phascum ludovicianum Sull. Mosses U. S. 16. 1856.
Phascum crispum var. *rostellatum* ? Hook. & Wils. in Drumm. Musc. Am. S. States 10. 1841.
Systegium erythrostegium Schimp. Proc. Am. Acad. Arts & Sci. **14:** 140. 1879.
Hymenostomum ludovicianum Andrews, Bryol. **27:** 1. 1924.

Plants up to 7 mm. high; differs from *A. Muhlenbergianum* in the longer, more slender leaves, usually with the margins mostly plane, but sometimes just as involute; costa in the perichaetial leaves often more excurrent. Seta much longer, from 0.5 mm. in poorly developed specimens to longer than the capsule, occasionally more than one from the same perichaetium; capsules more elongated, oblong-ovoid to shortly oblong-cylindric, reaching over 1 mm. in length, apiculate to subrostellate, often showing a line of demarkation between urn and indehiscent lid; spores about the same, mature in early spring. Type locality, New Orleans, Louisiana (Drumm. l. c. no. 10).

Illustrations:—Sull. l. c.; *Pl. 77.*
Exsiccati:—Drumm. l. c.; Holz. Musc. Acro. Bor. Am. 253.
On bare sterile soil; W. Virginia (Gray), and in the Gulf States.
Holzinger (Bryol. **7:** 8–10. 1904) makes this a synonym of *Hymenostomum rostellatum* (Brid.) Schimp. This was evidently the view of Hooker & Wilson. Undoubted specimens of *A. ludovicianum* from Mobile, Alabama (Mohr) in the herbarium of the U. S. National Museum, have the leaf margins as strongly involute as in *Sullivantii*, which does not agree with European descriptions of *H. rostellatum.* The Alabama plant is pretty certainly an *Astomum* as the oral membrane is not present.

3. WEISIA* Hedw. Sp. Musc. 64. 1801.

Plants small, cespitose, usually growing on rather dry calcareous or sandy soil or in crevices of rocks and walls, branching freely; upper leaves usually much the larger, erect spreading, strongly crisped when dry, elongate-lanceolate to ovate-lanceolate, with margins strongly involute above; costa usually shortly excurrent; basal leaf cells rectangular, hyaline, the upper small, rounded and thickly papillose. Seta usually much longer than the perichaetial leaves; capsule usually erect and symmetric, narrower toward the mouth, ovoid to ovoid-cylindric, often somewhat wrinkled when dry and empty; peristome teeth various, often short and irregular, sometimes even wanting. Type species, *W. viridula.*

Key.

1. Costa rarely over 50 μ in width at base	2.
Costa 60–80 μ in width at base	4.
2. Peristome lacking; capsule mouth partially closed by a vanishing membrane	3.
Peristome present, more or less rudimentary; spores 14–18 μ	4. *viridula.*
3. Leaves ligulate-lanceolate; spores 14–18 μ	2. *ligulaefolia.*
Leaves lanceolate to linear-lanceolate, scarcely to be distinguished from those of *viridula;* spores 18–25 μ	1. *microstoma.*
4. Leaves oblong-ovate, obtuse, glaucous with high branched papillae	6. *glauca.*
Leaf papillae simple, rather low	5.
5. Peristome lacking; capsule mouth closed by a vanishing membrane; spores 12–15 μ	3. *tortilis.*
Peristome present; no oral membrane; spores 15–23 μ	6.
6. Leaves ovate-lanceolate; peristome short, often rudimentary; spores 15–23 μ	5. *Andrewsii.*
Leaves linear from a narrowly ovate to oblong base; peristome of 32 slender papillose filaments (up to 0.5 mm.); spores about 15 μ	7. *jamaicensis.*

Subgenus Hymenostomum C. Muell.

Peristome lacking; capsule mouth closed by a vanishing membrane developed from the top of the columella.

* Spelled *Weissia* by Hedwig, but *Weissia* Ehrh. has been used for *Ulota* and the present spelling avoids confusion. The botanist for whom the genus was named appears to have spelled his name Weis or Weiss.

1. Weisia microstoma (Hedw.) C. Muell. Syn. **1**: 660. 1849.

Gymnostomum microstomum Hedw. Sp. Musc. 33. 1801.
Hymenostomum microstomum R. Br. Trans. Linn. Soc. **12**[2]: 572. 1819.

Gametophyte scarcely differing from that of *Weisia viridula*. Capsules are narrower at the mouth; operculum more slender; peristome lacking; mouth of capsule closed by a membrane due to the attachment of the top of the columella to the capsule wall just below the line of dehiscence. The capsules are much firmer and more solid in structure due to the persistence of the cells between the epidermis and the spore sac. Spores 18–20 μ, mature in spring. Type locality, European.

Illustrations:—Bry. Eur. *pl. 16, 17;* Braithw. Brit. Moss Fl. **1**: *pl. 34B;* Dixon, Handb. Brit. Mosses, *pl. 28L; Pl. 78.*
Exsiccati:—Sull. & Lesq., Musc. Bor. Am. (Ed. 2) 54; (Ed. 1) 376 is not this species.
On soil especially in old fields; Cambridge and Wakefield, Mass.; New Jersey and Ohio.* Probably elsewhere; likely confused with *W. viridula* with *peristome lacking.*

2. Weisia ligulaefolia (Bartr.) **n. comb.**

Hymenostomum ligulaefolium Bartr. Bryol. **30**: 78. 1927.

"Plants small, densely tufted, light green above, olive green below, 2–3 mm. high, simple or obscurely branched from the base; leaves strongly cirrhate-crisped when dry, erect-spreading when moist, ligulate-lanceolate, 1.5 mm. long, mucronate by the excurrent costa, margin involute in the upper half, plane below; costa brownish, about 50 μ wide toward the base, in cross section above the middle showing a median row of about 4 large guide cells with stereid bands above and below, the outer layer on the ventral side strongly differentiated; lower leaf cells rectangular, hyaline, changing obliquely to the papillose upper areolation; median cells quadrate to short rectangular, about 10 μ long by 7 μ wide, 4–5 rows toward the margins transversely rectangular, upper cells about 8 μ in diameter, hexagonal-quadrate, densely and minutely papillose, obscure; inner perichaetial leaves smaller than the stem leaves, margins flat, costa thin, pale, excurrent into a short mucro, hyaline more than half way up, upper cells chlorophyllose, papillose, about 5 μ in diameter. Synoicous and paroicous, antheridia few, together with the archegonia and in the axils of the inner perichaetial leaves; paraphyses few, filiform, shorter than the antheridia. Seta yellow, 2–3 mm. long; capsule oval, 0.6–0.8 mm. long without lid, wide mouthed, exothecal cells thin walled, rectangular to linear, 2–3 rows around the rim transversely oval with colored walls; gymnostomous, mouth closed by a more or less fugitive membrane; spores 14–18 μ in diameter, papillose; lid rostrate, slightly oblique, 0.3–0.4 mm. long; calyptra cucullate, extending below the middle of the capsule." Type locality, Sycamore Canyon, Baboquivari Mts., Pima Co. Arizona, March 20, 1927 (Bartram no. 1632). Type seen. *Pl. 76.*

"The synoicous inflorescence clearly distinguishes this species from all of its North American allies except *H. mexicanum* Card. from Mexico, which, in addition to being a much larger plant in all its parts, has the leaves of a very different outline from those of the Arizona species."

3. Weisia tortilis (Schwaegr.) C. Muell. Syn. **1**: 661. 1849.

Gymnostomum tortile Schwaegr. in Schrad. Neu. Bot. Jour. **4**: 17. *pl. 1.* 1810.
Gymnostomum condensum Voit in Sturm, Deutschl. Fl. **2**: part 11. 1810.
Weisia involuta Brid. Bryol. Univ. **1**: 336. 1826.
Hymenostomum tortile Bry. Eur. fasc. 33–36. 1846.
Mollia tortilis Braithw. Brit. Moss. Fl. **1**: 235. *pl. 34D.* 1885.

Plants larger than in *W. microstoma*, in dense tufts, 1–2 cm. high, usually less in American plants, easily detached and separated; leaves crowded, narrowly oblong-lanceolate, up to 2.4 mm. long, mostly less than 2 mm., erect-spreading, appressed and twisted to crisped when dry, obtuse, mucronate by the very stout (up to 80 μ or more in width) costa, which is reddish when old, in cross-section with 4–8 median guides and two wide stereid bands; margins widely incurved above, entire; basal cells rectangular, hyaline, passing rather abruptly into the small, about 7 μ, upper cells, which are opaque, rounded and densely papillose on both faces; perichaetial leaves longer, narrower in the upper part. Monoicous; seta 3–6 mm. long; capsule oblong-cylindric, narrower at the red mouth, which is more or less closed by an inconspicuous membrane;

* See Andrews, Bryol. **27**: 1–3. 1924.

urn about 1.75 mm. long; operculum beaked, about ½ the length of the urn; peristome lacking; spores 12–17 μ, mature in spring. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 15;* Braithw. l. c.; Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 28M; Pl. 78.*
New Mexico, Texas (Orcutt); Arizona (Bartram, no. 1718); Tennessee (Sharp). Ohio, Sharp.
Limestone rocks and ledges, especially in the crevices. "Usually sterile in the lower and more arid localities and seems to fruit freely only in the shelter of the canyons where moisture is more abundant" (Bartram, Bryol. **30**: 78). The relatively broader leaves, mucronate with the stout reddish excurrent costa, will help identify sterile plants. The leaves often appear acute by reason of the strongly infolded margins.

Subgenus EUWEISIA.

Plants without oral membrane and with peristome.

4. WEISIA VIRIDULA Hedw. Fund. **2**: 90. 1781; Sp. Musc. 68. 1801 (as a synonym).

Weisia controversa Hedw. Stirp. Crypt. **3**: 12. *pl. 5B* and Sp. Musc. 67. 1801.
Weisia microdonta Hedw. Sp. Musc. 67. *pl. 11.* 1801.
Weisia viridula var. *stenocarpa* Bry. Eur. *pl. 22*β. 1846.
W. viridula var. *densifolia* (Wils.) Bry. Eur. l. c. f. γ.
Gymnostomum Rauianum Aust. Bull. Torr. Club **5**: 21. 1874.
Weisia Brandegei Aust. Bull. Torr. Club **6**: 46. 1875.
Weisia rutilans var. *Ganderi* and other varieties of Macoun, Cat. Can. Pl. **6** & **7**. Not of Europe.
W. viridula var. *nitidula* R. & C. Bot. Gaz. **14**: 91. 1889.

(For a more complete synonymy of this much named plant see Braithw. Brit. Moss Fl. **1**: 236, 237. (Also Andrews in Bryol. **36**: 28–31. 1933.)

Plants in thin dense sods, bright- to yellowish-green; stems erect, often branching, up to 5 mm. or more in height; leaves gradually increasing in size from the bottom up, the upper up to 3 mm. long, broadly to narrowly lanceolate, acute to acuminate, erect-spreading when moist, crispate when dry; *margin strongly involute, entire,* often plane at and near the base; costa strong, excurrent into a sharp almost hyaline point; upper leaf cells papillose, obscure, roundish-hexagonal, 6 or 7 μ in diameter; basal elongated, rectangular, clear and mostly without papillae. Mostly monoicous; seta erect, 3–7 mm. long, light- to dark-yellow; capsules erect and symmetric, ovoid to oblong-cylindric, smooth or plicate when dry and empty, light to dark brown, often shining as if varnished, slightly or not at all contracted at the mouth when dry and empty; peristome teeth various, almost lacking with only one or two sections, or much longer, of 5 to 10 sections, lanceolate and sometimes perforate to narrowly linear, smooth or strongly papillose; operculum obliquely long-rostrate; spores 15–19, rarely 22 μ in diameter, rather coarsely papillose. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 21, 22;* M. H. M. *pl. 23;* Braithw. Brit. Moss Fl. **1**: *pl. 34E;* Dixon, Handbk. Brit. Mosses (Ed. 3) *pl. 29A;* Limpr. Laubm. **1**: 252. *f. 96.*
EXSICCATI:—Drumm. Musc. Am. 67, S. States 33; Sull. Musc. Allegh. 144, 145; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 37b, (Ed. 2) 49; Aust. Musc. Appal. 63 (as *Hymenostomum microstomum*) 65 to 69, Suppl. 465 (as *W. Rauei*); Holz. Musc. Acro. Bor. Am. 71, 550, 582; R. & C. Musc. Am. Sept. 354 (as *W. Wimmeriana*); Bartram, Mosses S. Arizona 108; Grout, Musci Perf. 67 approaches var. *australis.*
Western plants seem consistently more robust. The leaves may be longer or shorter, narrower or wider, but in this respect the species varies not much more than is often the case in other species. The variations on the capsules and peristomes as noted above are extremely puzzling. The shape of the capsules varies in the same tuft and the peristome teeth on the same capsule. These teeth are so fragile that it is difficult to be certain that one gets them all in a dissection, consequently it has seemed best to ignore many varietal names except in synonymy.
The var. *australis,* however, though it intergrades, is so distinct when typical, and also seems to be a geographical variant, that it seems worthy of recognition.
On bare soil in various situations; almost cosmopolitan; apparently common east of the rockies and less frequent west of them.

1a. Var. AUSTRALIS Aust. Musc. Appal. Suppl. 466. 1870 (nomen nudum) and Bull. Torr. Club **7**: 4. 1880.

Weisia longiseta Lesq. & James, Proc. Am. Acad. **14**: 125. 1879.

Seta longer, up to 1.5 cm., usually bright yellow; capsules oblong when ripe and full, cylindric and more or less plicate when dry and empty; peristome teeth well developed, sometimes perforate or bifid, reaching 0.24 μ.

Exsiccati:—Aust. l. c.; Holz. Musc. Acro. Bor. Am. 383, 53 as *W. viridula* var. *nitida;* R. & C. Musc. Am. Sept. 4.

Southern U. S. east of the Rocky Mts., north to S. Carolina.

Holzinger's 383 is a better example than Austin's 466. Lesq. & James describe the capsules as curved. Most of the capsules in Austin's 466 are straight. Described by Lesq. & James as dioicous but it is really polygamous. Numbers of fertile plants showed no antheridia, but an occasional plant bore an antheridial bud a little below the female flower. I think the same is true of the species proper.

While the species in N. America seems to vary in every possible character the southern var. *australis* seems to be a definite geographical variation; almost typical forms are found in the North West, although most plants are more robust. *Weisia Wimmeriana* R. & C. Musc. Am. Sept. 354, is a form of *W. viridula* with very short rudimentary peristome teeth, papillose and of about 2 joints. Brotherus in Engler & Prantl does not credit *W. Wimmeriana* to N. America. (See Bot. Gaz. **30:** 13. 1900.)

Weisia crispata (Nees & Hornsch.) C. Muell. reported from Missouri and Minnesota by Kindberg, Rev. Bryol. **34:** 27. 1907, is *W. viridula* as also his *W. convoluta* from Comox, Vancouver Id. in the U. S. National Museum (Cat. Can. Pl. **6:** 14. 1892), although specimens from Kindberg's own herbarium have been shown to be *Dicranoweisia crispula* (Hedw.) Lindb. (Williams, N. American Flora **15:** 95. 1913).

1b. Var. Wolfii (Lesq. & James) **n. comb.**

Weisia Wolfii Lesq. & James Proc. Am. Acad. **14:** 136. 1879.

Leaf margins mostly not inrolled but plane and curved so that the leaves in cross section form a semicircle; mucro of the excurrent costa longer than usual. Type from on the ground, Canton, Illinois (Wolf).

Through the kindness of Dr. Linder of the Farlow Herbarium of Harvard University I have been enabled to examine all of the type material in the James Herbarium. Most of the empty capsules are cylindric, but some of these are plicate and other capsules are ovoid; the seta is not longer than usual and such peristome teeth as were found were not unusual. Also some of the leaves had margins inrolled in the usual manner. Andrews (l. c. 30) states that plants of the original collection are autoicous.

As I have remarked under var. *australis* the species in this country seems polygamous, only a portion of the fertile plants bearing antheridia and some plants bearing nothing else; so that the dioicous feature seems of little importance though James in his notes states that "After cutting in pieces many plants I have at last found the male organs on separate plants, some 3–6 antheridia and very few very slender paraphyses, the perigonial leaves short, broad-ovate and the other leaves broader and much shorter than in the fruiting plants." I doubt if this is more than an aberrant form in this polymorphous species. This form comes very close to *W. mucronata* B. & S., and James at first referred it to that species in his notes. The spores, however are not larger nor the leaves wider.

A form with leaves approaching var. *Wolfii* but with slender, smooth, yellowish-hyaline peristome teeth is found in California and other Pacific Coast states. Such is Holzinger's Musc. Acro. Bor. Am. 332 from Washington. Andrews (Bryol. **36:** 31) states that some capsules in a collection show this character and others have normal papillose teeth. I suggest that the teeth in this form are immature and have not been fully developed. Cardot gave this form the herbarium name of *leiodonta.* Macoun collected at Amphitrite? Point, British Columbia plants that seem correctly labeled as var. *Wolfii.*

5. Weisia Andrewsii Bartr. Bryol. **30:** 82. 1927.

Subspecies, or perhaps better, variety of *W. viridula.*

Leaves broader, ovate-lanceolate to oblong-lanceolate, more broadly pointed; margins very strongly inrolled in upper part; upper leaf cells very strongly papillose, obscure, up to 10 μ in diameter; costa up to 65 μ wide in the widest part. Peristome rudimentary as figured, strongly papillose, more nearly normal, up to 5 articulations in some capsules of the type collection; up to 10 and perforate in plants from Texas (Jeremy, no. 365). Spores 18–23 μ. *Pl. 76.*

Type on shaded banks near mouth of Canada del Oro, Santa Catalina Mts., Pima Co., Arizona, April 1, 1927 (Bartram, no. 1689). Type collection issued as *W. crispata,* Holz. Musc. Acro. Bor. Am. 666.

The variations of the distinguishing characters in this and in closely related forms of *W. viridula* are so great that this is doubtfully more than a variety of that species.

6. Weisia glauca Bartr. Bryol. **30:** 80. 1927.

"Autoicous, male flower terminal on a short, fragile branch from near the base, antheridia 5–7, about 0.2 mm. long with few paryphases, inner perigonial leaves broadly ovate, blunt, margin flat, entire below, sinuate above the middle, areolation firm, pellucid, smooth or lightly papillose toward the apex. Plants densely tufted, up to 1 cm. high, erect, branched, dirty brown and sparingly radiculose below, pale glaucous

green above; leaves crisped when dry, not shining, erect-spreading and stiff with rather incurved points when moist, the upper oblong-ovate, obtuse, mucronate with the excurrent costa, lightly transversely undulate near the middle, 1.5–2 mm. long by 0.4–0.5 mm. wide, flat, margin erect below, narrowly inflexed above the middle, the lower leaves shorter and more gradually pointed;" perichaetial leaves narrower; "costa yellowish, 60–70 μ wide at the base, papillose on the inner face above the middle, excurrent into a short, pellucid mucro; basal cells rectangular, about 1 : 2, hyaline, changing abruptly about the middle of the leaf to the dense, obscure upper areolation, upper cells round-quadrate, 5–6 μ in diameter, chlorophyllose, densely papillose on both surfaces with high, branched papillae; seta yellow, flexuous, twisted to the right when dry, 5–6 mm. long; capsule erect, ovate-oblong, pale brown and lightly sulcate when empty, 1–1.2 mm. long, slightly contracted under the mouth when dry, exothecal cells oblong-hexagonal, thin walled, about 50 μ long by 30 μ wide, 4 or 5 rows around the mouth much smaller, transversely oval with incrassate, reddish walls; peristome teeth erect, pale, entire and blunt or cleft at the apex, papillose, projecting about 65 μ above the rim; lid obliquely rostrate, about 0.8 mm. long; spores 12–15 μ in diameter, papillose." *Pl. 76.*

"Type: Fort Davis, Jeff Davis Co., Texas, altitude about 5200 feet, May 22–25, 1926, C. R. Orcutt, *No. 7052.*"

"The long, branched papillae of the upper leaf cells clearly characterize this species and evidently account for the pale, glaucous color of the plants. The leaves are less concave than in either *W. Andrewsii* or *H. tortile*, the peristome more perfect, the margin more narrowly inflexed and the change from the basal to the upper areolation more abrupt and pronounced. The papillose upper cells often form a distinct 'V' on either side of which the pellucid basal cells extend obliquely up the margin, at which point the lamina is characteristically crisped," i.e. the hyaline basal cells extend farther up the margin after the manner of *Tortella*, but in a lesser degree. The upper leaves on plants of the type collection are oblong-lanceolate and have the upper portion relatively longer and narrower above than is shown in the illustration.

7. Weisia jamaicensis (Mitt.) **n. comb.**

Trichostomum jamaicense Jaegr. Ber. St. Gall. Nat. Ges. **1871–1872:** 397. 1873.
Tortula jamaicensis Mitt. Jour. Linn. Soc. **12:** 147. 1869.

Plants dark green above, brown below, apparently in rather loose mats, up to 2 cm. high; stems branching; leaves crisped when dry, spreading when moist, *linear from a broader subsheathing, oblong to* almost ovate base, up to 4 mm. long, narrowly acute, concave; margins entire, *strongly involute above; costa strong, about 75 μ wide at base,* usually excurrent into a short acute point made up of elongate cells, in cross section nearly cylindric with median guides and large dorsal and ventral stereid bands; basal cells narrowly rectangular, rather thick-walled, lower about 7 μ wide, 2–5 : 1, more nearly hyaline near the margin; the basal cells gradually become smaller and thicker-walled, merging into smaller (about 5 μ) thicker-walled obscure upper cells, which are rounded to quadrate in outline, strongly papillose on both sides with rather low multiple papillae; perichaetial leaves little different. Probably dioicous; seta yellow to orange, darker with age, 1–1.5 cm. long, erect; capsule cylindric, yellowish, urn 2–2.5 mm. long; operculum rostrate, about 1 mm. long, capsule mouth dark red; exothecial cells rectangular; annulus lacking; *peristome of 32 filiform papillose divisions, jointed and more or less anastomosing, especially when immature,* from a narrow basal membrane, up to 0.5 mm. long; spores about 15 μ, mature in autumn. Type locality, Jamaica; type seen.

Illustration:—*Pl. 84.*

Sterile depauperate plants have been found in Oklahoma (*Sharp*); Texas (*Mrs. E. A. Harris*); Arizona (*Bartram*). Common in the West Indies.

The leaves strongly resemble *Weisia* as do some peristomes from capsules not quite mature, while other old peristomes from the same lot are more like *Desmatodon* or *Barbula* but have the filaments more or less united in pairs.

4. GYMNOSTOMUM Hedw. Sp. Musc. 30. 1801 (in part); Sm. Fl. Britt. **3:**1163. 1804.

Densely cespitose, rusty below, densely foliate, growing mostly in limestone regions; leaves gradually increasing in size upwards, scarcely crisped but more or less contorted and appressed when dry, more or less keeled, with rather low papillae on both surfaces of lamina and costa; margins plane, entire; costa strong, vanishing below the apex; upper leaf cells rounded-quadrate, obscure (except *curvirostre*), the lower rectangular, becoming smooth and clear. Dioicous; seta long-exserted, erect; capsules erect and symmetric, ovoid to oblong-ovoid, smooth and glossy at maturity; operculum long-rostrate; peristome and annulus

lacking; calyptra cucullate, covering half the capsule. It is difficult to say what should be considered the type species. Hedwig in the Sp. Muscorum names several gymnostomous species now referred to other genera before he names any now included in the genus. Contrary to most modern writers, *curvirostre* is included instead of putting it in the genus *Hymenostylium*. Type species probably *G. aeruginosa*.

KEY.

1. Stems very short, usually under 2 cm.; leaves narrowly lingulate to ligulate; some or all obtuse ..... 3.
   Stems usually longer, up to 10 cm.; leaves acute to subacute ..... 2.
2. Upper leaf cells obscure, 7–12 μ; operculum not persistent ..... *1. aeruginosum.*
   Upper leaf cells clear, 12–15 μ; operculum usually remaining attached to the exserted columella for a time ..... *4. recurvirostrum.*
3. Stems with central strand; capsules with a large persistent annulus ..... *3. tenue.*
   Stems without ventral strand; annulus lacking ..... *2. calcareum.*

G. platyphyllum Kindb. Bull. Torr. Club **17**: 84. 1890, is a synonym of *Didymodon tophaceus* (Brid.) Jur.

1. GYMNOSTOMUM AERUGINOSUM Sm. Fl. Brit. **3**: 1163. 1804.

Gymnostomum rupestre Schleich. Cat. 29. 1807.
Weisia rupestris C. Muell. Syn. **1**: 657. 1849.
Mollia aeruginosa Lindb. Musc. Scand. 21. 1879.

Plants in rather thick dense cushions, 1–3 cm. high, sometimes up to 8 cm., dull olive to bright green above; stems slender, branched; leaves crowded, often in interrupted tufts, erect-open to spreading-recurved, when dry appressed to incurved, somewhat twisted, gradually larger above, oblong- to linear-lanceolate, 0.75–1.5 mm. long, keeled, tapering to a subacute or acutely obtuse apex; margins plane, entire, often appearing crenulate with fine papillae; costa stout, at base about 70 μ wide, narrower and more indistinct above, in cross section biconvex, with 4–6 median guides, ventral stereid band weak, ending below the apex; basal cells rectangular and hyaline; cells of upper part of leaf small, 7–12 μ, densely papillose on both sides and obscure, rounded quadrate and thick-walled; perichaetial leaves little different, more sheathing at base. Dioicous; seta 2–4 mm. in length, occasionally longer; capsule ovoid to short-oblong, *thin-walled, yellowish-brown*, reddish at the mouth; operculum wholly dehiscent; spores 10–12 μ, mature late summer or autumn. Type locality, Switzerland.

ILLUSTRATIONS:—Bry. Eur. *pl. 33 & 34;* Braithw. Brit. Moss Fl. **1**: *pl. 35B;* Dixon, Handbk. *pl. 29F;* M. H. M. *pl. 25.*

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 3, 3a and 4, 4a (as *G. calcareum*); Grout, Musci Perf. 179; Drumm. Musc. Am. 24, S. States 21; Sull. Musc. Allegh. 194; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 38, 39; Aust. Musc. Appal. 60, 61 (as *G. calcareum*); Bartr. Mosses S. Arizona 88.

On moist rocks in limestone regions; southern Canada across the continent; eastern U. S. to Texas, west to Arizona.

The smaller more obscure leaf cells and the plane leaf margins will distinguish this from *G. curvirostre* even when sterile.

The leaves are not as different from those of *G. calcareum* as some descriptions indicate, but in that species some of the leaves will be rounded-obtuse; the plants are normally much smaller and the species is much less frequent.

2. GYMNOSTOMUM CALCAREUM Nees & Hornsch. Bry. Germ. **1**: 53. *pl. 10, f. 15.* 1823.

Gymnostomum viridulum Bry. Eur. *pl. 31*, fasc. 33–36. 1846.
Gymnostomum tenue of the Lesq. & James Manual, and of Macoun and Kindb.*
Gymnostomum pusillum Kindb.; Macoun, Cat. Can. Pl. **7**: 186. 1902.

Smaller than *G. recurvirostrum*, 1–10 mm. high, rarely larger; leaves about 1 mm. long, densely papillose and obscure except near the base, some rounded-obtuse and lingulate, many, if not most lanceolate and subacute; *margins plane;* basal cells near costa rectangular, smooth and pellucid, 2–3 : 1. Seta 3–5 mm.

* See Andrews Bryol. **25**: 97–100. 1922.

long; capsule oblong to obovoid (var. *viridulum*), becoming cylindric with age, usually somewhat narrowed at the mouth when dry and empty; annulus lacking; spores 8–10 μ in diameter, mature in summer. Type locality European.

ILLUSTRATIONS:—Bry. Eur. *pl. 31, 32;* Braithw., Brit. Moss. Fl. **1:** *pl. 35A;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 29D;* M. H. M. *pl. 26; Pl. 74D.* Pl. 123

EXSICCATI:—Bauer, Musci Eur. & Amer. 1816; Bartram, Mosses S. Arizona 134; Grout, Musci Perf. 189 (var. *intermedium*); Holz. Musc. Acro. Bor. Am. 377; Drumm. Musc. Am. 21 (as *G. tenue*).

The var. *Winonense* Holz. Bot. Gaz. **22:** 1. 1896, seems to be merely a reduced form. Var. *brevifolium* Schimp. is a synonym of *G. viridulum* and is reduced to synonymy by Limpricht, Laubm. **1:** 233. Var. *perpusillum* Sull. Pacific R. R. Rep. **4:** 185, seems to be another unimportant variation.

The variations upon which the above varieties are founded seem to be such as may be accounted for by a difference in habitat conditions or differences in climatic conditions.

On moist rocks containing more or less lime; Newfoundland to California, south to W. Virginia and Arizona.

3. GYMNOSTOMUM TENUE Hedw. Sp. Musc. 37. 1801.

Weisia tenuis C. Muell. Syn. **1:** 660. 1849.
Mollia tenuis Lindb. Musc. Scand. 21. 1879.
Gyroweisia tenuis Schimp. Syn. (Ed. 2) 38. 1876.

Plants in dense thin mats, 1–2 mm. high, bright green above; leaves up to 1 mm. long, erect-open to slightly recurved when moist, erect, rigid and but little contorted when dry; narrowly ligulate, rounded-obtuse at the apex; margins plane; costa ¼ the width of the leaf at the base (about 20–30 μ wide), ending in or below the apex; hyaline basal cells rectangular, 3–6 : 1, gradually merging into the thick-walled upper cells, which are irregular to subquadrate, sometimes 2–3 : 1, papillose on both sides but distinct, 7–10 μ in longest dimension; perichaetial leaves much longer and more sheathing at base. Dioicous; seta erect, up to 7 mm. long; capsule narrowly oblong; urn ± 1.3 mm. long; operculum conic-apiculate; annulus large, persistent; spores 8–10, rarely 14 μ. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 30;* Braithw. Brit. Moss Fl. **1:** *pl. 34G;* Dixon, Handb. Brit. Mosses, (Ed. 3) *pl. 29C; Pl. 74C.* Pl. 122

Keweenaw Peninsula, Houghton Co., Michigan (*Steere*). All other reported collections have proved to be something else, mostly *G. calcareum.* Holzinger's Musc. Acro. Bor. Am. 311 is sterile *Diphyscium.*

Usually on calcareous rocks. Distinguished by its small size, uniformly broadly obtuse leaves with elongate basal cells, central strand in stem, and large persistent annulus.

4. GYMNOSTOMUM RECURVIROSTRUM Hedw. Sp. Musc. 33. 1801.

Gymnostomum curvirostrum Brid. Musc. Recent. **2**[1]: 45. 1798; Sp. Musc. **1:** 39. 1806.
Weissia curvirostris C. Muell. Syn. **1:** 658. 1849.
Hymenostylium curvirostre Mitt. Jour. Linn. Soc. **1:** Suppl. 32. 1859.
Barbula curvirostris Lindb. Musc. Scand. 22. 1879.

Plants in soft dense sods, bright- to yellowish-green, darker and rusty below, up to 10 cm. in length but usually shorter, branched, fragile; leaves little contorted when dry, erect to erect-spreading when moist, lanceolate-acuminate, acute, keeled, with one or both margins recurved below, entire or nearly so, 1–1.5 mm. long; upper leaf cells distinct, rounded to subquadrate or rectangular, 7–10 μ wide, 1–3 : 1, papillae low and comparatively few; basal cells elongate-rectangular; costa vanishing below the apex, prominent on the back. Dioicous; seta 8–10 mm. long, reddish at base; capsule dark red-brown, about 1 mm. long, ovoid to subspherical, rarely oblong, thick-walled, widest at the mouth when dry and empty; annulus apparently lacking, composed of a single row of small persistent cells usually ignored; peristome lacking; operculum long and slenderly beaked, remaining attached to the columella after dehiscence; spores 15–22 μ. Mature in late summer to autumn. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 35, 36;* M. H. M. *pl. 24;* Braithw. Brit. Moss. Fl. **1:** *pl. 38D;* Dixon, Handb. Brit. Mosses *pl. 29E;* Jennings, Mosses W. Pennsylvania *pl. 12.*

EXSICCATI:—Drumm. Musc. Am. 25, 26; Sull. Musc. Allegh. 193; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 41, (Ed. 2) 53; Aust. Musc. Appal. 61.

Moist cliffs, especially those containing lime; Alaska to Labrador, South to California and S. Carolina; fairly common.

4a. Var. SCABRUM Lindb. Musc. Scand. 22. 1879.

Leaves more densely papillose; stems also papillose. When sterile often confused with *G. rupestre.* Probably with the range of the species.

4b. Var. COMMUTATA (Mitt.) Dixon, Handb. Brit. Mosses (Ed. 1) 212. 1896.

Hymenostomum commutatum Mitt. Jour. Linn. Soc. **1**: Suppl. 32. 1859.

Leaves narrower, more rigid, erect; leaf cells smooth, larger, reaching 30 μ, many rounded rectangular. Nova Scotia, Prince, no. 6847. Dixon, Handb. (Ed. 3) 234, states that this has some claims to a higher rank, but that intermediate forms are found. Prince's plant would not be referred to this species at first sight.

5. EUCLADIUM Bry. Eur. fasc. 33–36. *pl. 40.* 1846.

We have one species which is intermediate between the *Dicranaceae* and *Pottiaceae* and has been placed in both families.

EUCLADIUM VERTICILLATUM (L. Brid.) Bry. Eur. l. c.

Bryum verticillatum L. Sp. Plant. **2**: 1120. 1753, & Brid. Musc. Recent. **2**^{3}: 40. 1803.
Weisia verticillata Brid. Sp. Musc. **1**: 121. 1806.
Hymenostylium verticillatum Mitt. Jour. Linn. Soc. **1**: suppl. 32. 1859.
Mollia verticillata Lindb. Musc. Scand. 21. 1879.

Plants in dense tufts, 1–5 cm. high, pale glaucous-green above, often whitish by reason of encrusted lime deposit; stems slender, fragile, freely branching; leaves erect-open to widely spreading when moist, apprest and scarcely twisted when dry, long linear-lanceolate to linear-subulate, reaching 2.5 mm. in length, often slightly broader at base, acute or often apiculate by the excurrent costa; margin plane, *toothed just above the base at the upper margin of the hyaline basal cells;* costa stout, sometimes ⅓ the width of the leaf above the base, percurrent to shortly excurrent, or at times vanishing in the apex; basal cells large, rectangular to oblong-hexagonal, up to 59 μ in length, 5–10 : 1, hyaline, smooth; upper cells rectangular to quadrate or irregular, rounded, 7–12 μ in longest dimension, thick-walled, papillose. Dioicous; seta 1–2 cm. long; capsule oblong-ovoid, erect and symmetric, thick walled; annulus very narrow; operculum obliquely beaked; peristome teeth 16, often irregularly united at base or perforate, papillose; spores 10–14 μ, in summer, rarely produced. Type locality European.

ILLUSTRATIONS:—Bry. Eur. l. c.; Braithw. Brit. Moss. Fl. **1**: *pl. 35C;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 29G; Pl. 79.*

EXSICCATI:—Bartram, Mosses S. Arizona 23; Holz. Musc. Acro. Bor. Am. 303. Wet rocks rich in lime; British Columbia, Newfoundland; south to Arizona, Oklahoma, Tennessee and Virginia; fairly common in California.

Holzinger's 303 specimens are the only U. S. ones with sporophytes. There is a great deal of variation in the outline of the leaves, some being little wider at the base; in the plants from California the teeth at the base are less conspicuous. While most leaves are papillose above with low blunt papillae the plants from Arizona have leaves covered with rather high sharp papillae.

6. RHAMPHIDIUM Mitt. Jour. Linn. Soc. **12**: 45. 1869.

Small slender plants, loosely gregarious; stems without central strand; leaves closely long-sheathing at base, with a lanceolate to lanceolate-lingulate spreading portion, which is appressed when dry; costa strong, vanishing below the apex, sometimes rough on the back above; cells of the sheathing base hyaline, narrowly rhomboidal to linear, hyaline; upper cells small, irregular, quadrate or short-rectangular, smooth; perichaetial leaves longer, more erect. Dioicous; seta long, smooth; capsule oblong-cylindric to obovate; annulus present, detached in fragments; peristome teeth 16, from a narrow basal membrane, divided nearly to the base *into two filiform strongly papillose divisions*, without nodes, sometimes a little twisted; operculum long-rostrate; calyptra cucullate. Type species *R. macrostegium* (Sull.) Mitt.

Differs from *Trichostomum* in the long-sheathing leaves and better developed peristome; from smooth-leaved *Barbulae* in the sheathing leaf base and less twisted peristome. In many respects it comes close to some species of *Ditrichum.*

RHAMPHIDIUM MACROSTEGIUM (Sull.) Mitt. l. c.

Trichostomum macrostegium Sull. Proc. Am. Acad. Aug. 1861; Musci Cubenses Wrightiani no. 24; Icones Musc. Suppl. 35. *pl. 22.* 1874.

Stems not over 6 mm. long; *sheathing leaf base narrowest at insertion, often longer than the spreading portion in the lower leaves;* its hyaline cells elongate-rhomboidal to linear, narrower toward the margin, reaching 75 μ in length, mostly shorter; spreading upper portion of leaf very concave, sometimes subtubulose; margins entire, or somewhat serrulate at apex; upper cells about 7 μ in width, irregular, or quadrate to short-rectangular, thick-walled; perichaetial leaves much longer, the inner over 2 mm. long, with spreading portion as long as, or longer than the sheathing base. Seta up to 1 cm. long, erect, reddish; capsule oblong-cylindric, inclined, somewhat curved; urn ± 1 mm. long; *operculum with a very slender needle-like beak longer than the urn;* peristome teeth as described for the genus, *very slender and fragile at the tips.* Type, Musci Cubenses Wrightiani no. 24, on dry banks, Cuba. Type seen.

ILLUSTRATIONS:—Sull. l. c.; *Pl. 79.*

On clay banks, Donaldsonville, Louisiana and Mobile, Alabama (Mohr); Mohr's Alabama plant seen and studied, courtesy of the U. S. National Museum. Sullivant, Icones l. c. says, "The distinguishing characters of this species are the sheathing bases of its leaves . . . ; the remarkably long operculum . . . and the finely attenuated apices of the teeth of the peristome."

7. TRICHOSTOMUM Bruch, Flora **2**: 393. 1829, emend.; not of Hedw. 1801.
Nomen conservandum.

Plants usually found on rocks and soil in dense mats or tufts, green to yellow-green, medium sized to large; stems with central strand; leaves usually narrow, crisped when dry, variously spreading when moist, more or less concave or keeled; margins plane or incurved, often undulate; costa strong, percurrent to shortly excurrent, in cross section with median guides and two stereid bands; upper leaf cells unistratose, small and rounded, papillose both sides; basal elongate-rectangular, mostly hyaline; perichaetial leaves little different. Dioicous, rarely monoicous; seta long, erect; capsule cylindric to oblong-cylindric, mostly erect and symmetric, occasionally somewhat arcuate; annulus usually present; calyptra cucullate; operculum conic-rostrate; peristome with or without basal membrane, ventral and dorsal plates about equally developed, the 16 teeth erect, papillose (spirally thickened in *T. spirale*), split into 2 filiform divisions, irregularly perforate, or occasionally entire with median line, *shorter than in Barbula* or *Tortella, untwisted.* Type species, *T. brachydontium* Bruch.

T. pyriforme Lesq. & James Man. 109. 1884, type, has been examined by R. S. Williams and myself and we agree that it is *Dicranella Herminieri* Besch.

T. trachyhneuron (Kindb.) Paris, *Didymodon trachyneuron* Kindb. Eur. & N. American Bryin. 275. 1897, is probably a synonym of *T. cylindricum* as specimens in the N. Y. Botanical Garden from Owen Sound (Macoun, 1875) and his N. Wakefield, Quebec collection at Ottawa are both *T. cylindricum.* The 1874 collection from Bruce Co., Ontario is *Gymnostomum calcareum* with *Desmatodon cernuus* on the side.

KEY

1. Leaves longly and narrowly acuminate ..... *3. cuspidatissimum.*
   Leaves broadly acute to short-acuminate ..... 2.
2. Leaves up to 6 mm. long; dioicous; peristome teeth papillose ..... *1. cylindricum.*
   Leaves usually less than 2 mm. long; monoicous; peristome teeth not papillose but spirally marked ..... *2. spirale.*

1. TRICHOSTOMUM CYLINDRICUM (Bruch) C. Muell. Syn. **1**: 586. 1849.
(Not of Hedw. Sp. Musc. 107. 1801.)

Weisia cylindrica Bruch in Brid. Bryol. Univ. 806. 1826.
Weisia tenuirostris Hook. & Tayl. Musc. Brit. (Ed. 2) 83. *pl. 3*, Suppl. 1827.
Didymodon cylindricus Bry. Eur. fasc. 29–30. *pl. 187.* 1846. (Not of Wahlenb. Fl. Suec. **2**: 764. 1826.)
Trichostomum tenuirostre Lindb. de Tort. 225. 1864.
Mollia tenuirostris Lindb. Musc. Scand. 21. 1879.
Trichostomum sitkanum Card. & Thér. Proc. Wash. Acad. Sci. **4**: 303. *pl. 14, f. 1a–1e.* 1902.

Plants in loose tufts, yellowish-green above, brown below; stems erect, branching, up to 2 cm. high, usually less; central strand weak or lacking; leaves larger above, reaching 4 mm. or more in some plants, linear-lanceolate to ligulate, gradually to abruptly acute, varying extremely in breadth and in acuteness of apex, when dry crisped and contorted, brittle, flexuous-spreading from an erect base when moist, more or less concave; margins plane, undulate, entire or irregular to notched; lower cells elongate-rectangular, sometimes inflated at base, mostly hyaline, gradually merging into the small upper cells, not extending farther up the margins than next the costa; upper cells incrassate, dense and obscure, with several small papillae on each surface, rounded-quadrate to hexagonal, 7–10 μ in diameter; costa strong, usually shortly excurrent into a short apiculus which may bear a lateral tooth or two and consisting of larger clearer cells; in cross section with a median row of guides and two stereid bands, the ventral much the smaller. Dioicous; seta erect, slender, yellowish, 1–1.5 cm. long, sometimes in pairs; capsule cylindric, erect and symmetric or nearly so, pale brown, somewhat irregularly wrinkled when dry and empty; operculum conic-rostrate, the beak oblique and about ½ the length of the urn; calyptra cucullate; annulus narrow; peristome teeth short, not twisted, linear-subulate or irregular and perforate, fragile, smooth or slightly papillose; spores 10–14 μ, mature in autumn, rarely produced. Type locality, Zweibrücken, Germany.

Illustrations:—Bry. Eur. l. c.; Dixon, Handbk. Brit. Mosses (Ed. 3) *pl. 29K;* Braithw. Brit. Moss Fl. **1**: *pl. 36B;* M. H. M. *pl. 30;* Limpr. Laubm. **1**: figs. 165, 166.

Exsiccati:—Aust. Musc. Appal. 114; Grout, Musci Perf. 116; Holz. Musc. Acro. Bor. Am. 274 (as *T. flavovirens*); Bartram, Mosses S. Arizona 49. Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 106b, (Ed. 2) 158 (mostly).

On moist rocks and even in brooks in cool shaded places in hills and mountains; also on bases of stumps and trees; Greenland to Manitoba and south to the Mountains of North Carolina and Arizona.

The Bry. Eur. plate represents the narrow leaved form with entire margins found at base of trees in N. Carolina. On moist cliffs nearby the leaves were so much larger that it challenges belief that they can be the same species. These two forms might well be called f. *angustifolia* and f. *latifolia*.

2. Trichostomum spirale **n. sp.**

Plantae *T. cylindrico* parvo similes, pervirides; folia ± 1.7 mm. longa; cellulae ± 7 μ; flores autoici; peristomii dentes spiris signati; sine papillis; sporae ± 12 μ.

Resembling a small *T. cylindricum*; plants dark green; leaves less than 2 mm. long, margins less irregular; leaf cells smaller, mostly about 7 μ. Autoicous; peristome teeth marked with spiral lines instead of papillae; spores 10–15 μ, mature late autumn. Type locality, *on rotten wood*, St. Croix Falls, Polk Co., Wisconsin, Nov. 1897 (C. F. Baker). *Pl. 84.*

3. Trichostomum cuspidatissimum Card. & Thér. Proc. Wash. Acad. Sci. **4**: 302. 1902.
(Harriman Alaska Expedition.)

Densely cespitose, brownish-green; stems erect, reaching 5 cm. in height, branching densely foliate; leaves crisped when dry, erect-spreading when moist, crowded at the top of the stem and branches, fragile and the apical portion often broken off, lanceolate-linear from a broader sub-sheathing base, concave, narrowly long-acuminate, 3–3.5 mm. long by 0.45–0.7 mm. wide; margins plane, crenulate with large multiple papillae above; costa 80–90 μ wide at base, long-excurrent into a colored awn-like point, in cross section with a median row of guides between two stereid bands; basal cells rectangular, 3–6 : 1, yellowish and somewhat pitted when old, smooth, sometimes nearly linear, gradually changing into the smaller upper cells, which are mostly subquadrate, obscure, 10–12 μ in diameter, strongly pleuripapillate.

Hall Island Alaska (Brewer & Coe no. 674). Type duplicate seen.

Illustrations:—Card. & Thér. l. c. *pl. 13, f. 4a–4e; Pl. 81.*

Resembling *T. mutabile* Bruch, but distinct by its larger strongly pleuripapillate leaf cells and papillose-crenulate leaf margins.

Trichostomum crispulum Bruch, Flora **12**: 395. *pl. 1, f. 4.* 1829,

is reported from Guadalupe Island, California in the Lesq. & James Manual, 109. 1884, but the specimen cannot be located. It has never been reported north of Mexico. It strongly resembles the larger and lighter colored *Tortella flavovirens* in many ways, especially as the leaves are cucullate at apex. It is distinguished easily by the lack of the V-shaped area of elongated hyaline basal cells.

8. TIMMIELLA (DeNot.) Limpr. Laubm. **1**: 590. 1888.

Timmiella, section of *Trichostomum* DeNot. Cron. Briol. Ital. **1**: 14. 1886.

Plants in wide loose tufts, medium sized; central strand present; upper leaves much larger, the lower almost scale-like, leaves when dry crispate, closely twisted together, with margins incurved, when moist erect spreading, long and narrowly oblong-lanceolate, acute to narrowly obtuse, more or less serrate above; margins widely incurved above; costa very wide and stout, ending in or near the apex, in cross section with a median row of guides with a strong stereid band above and below, smooth on the dorsal side; *lamina bistratose* (except in the region of rectangular subhyaline basal cells and narrow margin), and very obscure, *the ventral layer of cells larger and very strongly mamillose, the dorsal layer smooth;* upper cells small, 7–9 μ, rounded-quadrate; perichaetial leaves little different. Capsules cylindric, erect and symmetric, or somewhat bent; seta long; calyptra cucullate, smooth; operculum conic, shortly or longly rostrate, much shorter than the urn, the cells in a left spiral; stomata at capsule base, superficial; peristome from a very narrow basal membrane, its 32 divisions filiform, long, sometimes twisted, strongly papillose, without nodes; spores small and smooth. Type species, *T. anomala?*

Distinguished from *Trichostomum*, *Barbula* and related genera by the bistratose leaf lamina with mamillose ventral cells. Found mostly in calcareous regions.

Key.

1. Monoicous; peristome twisted at least one turn; operculum ⅓ length of urn .... *1. anomala.*
   Dioicous; peristome not twisted ..... *2.*
2. Seta variously bent and twisted when dry; operculum about ½ the length of the urn ..... *2. flexiseta.*
   Seta little contorted; operculum less than ⅓ the length of the urn ..... *2a. vancouveriensis.*

1. Timmiella anomala (Bry. Eur.) Limpr. Laubm. **1**: 592. *f. 173*, 1888.

Barbula anomala Bry. Eur. fasc. 13–15. *pl. 169.* 1842.
Trichostomum anomalum Schimp. Bry. Eur. Corol. 28. 1856.

Plants in loose mats or tufts, dirty green, up to 2 cm. high, usually less, more or less branched, sometimes with parphyses-like structures in the leaf axils; central strand present; upper leaves narrowly oblong-linear, little narrowed above the appressed base, up to 4–5 mm. long, somewhat undulate below, erect-spreading when moist, when dry appressed and contorted to crisped; margin usually broadly incurved, closely so when dry, more or less serrate above with distant teeth; costa broad, ending in or near the apex, in cross section with a several-celled row of median guides and a strong ventral and dorsal stereid band; leaf cells as described for the genus, basal marginal linear, the upper 7–9 μ in diameter. Autoicous or synoicous; seta 15–25 mm. long, occasionally spirally twisted; capsule erect or inclined, cylindric, lightly wrinkled when dry, sometimes slightly arcuate, urn ± 4 mm. long; operculum ⅓ the length of the urn; conic-rostrate; annulus very large, deciduous; exothecial cells sublinear; stomata in two rows, few; peristome teeth inserted at the mouth from a very narrow (50 μ high) basal tube, the 32 peristome branches long, slender and at least once turn twisted, ± 1 mm. long, reddish, strongly papillose; spores 10–12 μ, mature in summer. Type locality, northern Italy.

Illustrations:—Bry. Eur. & Limpr. l. c.; Husnot, Musc. Gall. *pl. 25; Pl. 80* and *83*.
Exsiccati:—Holz. Musc. Acro. Bor. Am. 647; Bartram, Mosses S. Arizona 24.
On soil; California; Arizona, 5000 ft. (*Bartram*); Florida (according to Lesq. & James, Man. 110, doubtful). Reported from near Victoria, Vancouver Id. (Macoun, Cat. Can. Pl. **7**: 210.)

2. Timmiella flexiseta (Bruch) Limpr. l. c. 595. 1888.

Trichostomum flexisetum Bruch, in Muell. Muscis Sardosis & in Denkschr. Akad. Muenschen **2**: 285. *pl. 2.* 1828.
Trichostomum flexipes Bry. Eur. fasc. 18–20. *pl. 171.* 1843.
Trichostomum crassinerve Hampe, Linnaea **30**: 456. 1860.
Trichostomum coloradense Aust. Bot. Gaz. **2**: 90. 1877. (Type seen.)

Difficult to distinguish from *T. anomala* when sterile, as a rule with leaves more crisped when dry. Dioicous; seta flexuous and sometimes reflexed when dry; peristome about 50 μ long, *little or not at all twisted;* operculum up to ½ the length of the urn; spores 8–10 μ. Type locality Sardinia.

Illustrations:—Bry. Eur. l. c.; Husnot, Musc. Gall. *pl. 26; Pl. 80.*
Exsiccati:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 100 d, (Ed. 2) 148; Bartram, Mosses S. Arizona 111.
On moist banks; California and Arizona. Most plants from California including the plants referred to in the Lesq. & James Manual, p. 110, as *Trichostomum flavovirens* var. *crassinerve* (Hampe) appear to be var. *vancouveriensis.*

2a. Var. vancouveriensis (Broth.) **n. comb.**

Timmiella vancouveriensis Broth. Bot. Centralbl. **44:** 387. 1890.

Sheathing base of leaves much broader than the spreading limb to which it is rather abruptly narrowed; seta less flexuous, often nearly straight; peristome up to 0.6 mm.; capsule urn nearly 2 mm. long and operculum about 1 mm.; spores about 10 μ in diameter. In some specimens the dorsal lamina cells are bulging.

Exsiccati:—Holz. Musc. Acro. Bor. Am. 183 (as *T. anomala*) near Seattle, Washington (*Bailey*); Howe, Musci Californici 24, Mt. Tamalapais, Marin Co.
Specimens from the type locality, coll. Macoun, com. by the Canadian National Museum at Ottawa, have a strongly curved seta, operculum fully ⅓ the length of the urn, spores immature.
Dr. Brotherus in a description of the species in Hedwigia **32:** 203. 1893, states that it differs in its larger size, shorter curved operculum and larger spores, 12–14 μ. These differences are far too slight to distinguish species where there is so much variation in these characters. *T. flexiseta* itself, I cannot distinguish from *T. anomala* when sterile and without antheridia or archegonia. The differences in the leaf apices as shown in the two Bry. Eur. plates are negligible, for both shapes of leaf apex may be found on the same plant of either species. The type of the variety has not been seen and may not be the same as the Vancouver Island specimen examined.

*9. PLEUROCHAETE Lindb. de Tort. 253. 1864.

By Mrs. Inez M. Haring, M.A.

Barbulae sp. Brid. Bry. Univ. **1:** 833. 1826.
Tortellae sp. Limpr. Laubm. **1:** 607. 1890.

Plants flexuose-erect, sometimes somewhat incumbent, in very loose tufts, or scattered, not radiculose; stems often much branched, mostly flexuose; leaves long-lanceolate, sometimes shorter, *from a sheathing base, serrate at the apex, sometimes down the margin into the hyaline cells;* costa thick, often percurrent or excurrent, in cross-section with median guides and two stereid bands; upper leaf-cells quadrate, papillose, *median basal leaf-cells colored,* rectangular, *marginal basal leaf-cells hyaline, rectangular, more in number at the base, decreasing to 1–2 up the margin, and becoming smaller, not reaching the costa.* Dioicous; *fruit axillary;* peristome long, *slightly twisted,* papillose.

A distinctive genus, similar in some ways to *Tortella* and placed there by some authors. The genus differs essentially from *Tortella* in that the basal hyaline cells do not reach the costa but form a distinct band along the margin; the stems are not radiculose; while the leaves are serrate at the apex and sometimes down the margin; archegonia axillary. Only one species has been found in North America.
Type species, *P. squarrosa.*

Pleurochaete squarrosa (Brid.) Lindb. de Tort. 253. 1864.

Barbula squarrosa Brid. Bry. Univ. **1:** 833. 1826.
Tortula squarrosa De Not. Mem. Acad. Torin. 321. 1838.
Barbula tortuosa Bryol. Eur. fasc. 13–15, Mon. 26, *pl. 152.* 1842.
Tortella squarrosa (Brid.) Limpr. Laubm. **1:** 607. 1890.

Plants in loose tufts or scattered, frequently mixed with other plant material, 1–10 cm. high, yellow-green above for some distance down the stem to the brown below; *stem flexuose-erect* to incumbent, branched, with a central strand; leaves flexuose, sometimes crisped especially at the tip when dry, *squarrose when*

* Botanical Study No 18, Department of Botany, Vassar College, Poughkeepsie, New York.

moist, crowded at the tip, sometimes along the stem, longest just at tip or immediately below, lanceolate-acuminate to shorter acuminate, quickly narrowed from a *wide, erect, sheathing base*, 2.5–5 mm. long; costa stout, usually excurrent, sometimes percurrent; *margins serrate at apex*, usually by the extension of the cell walls, sometimes by the cells themselves, often down the margin to finely denticulate at base, undulate, sometimes involute; *upper leaf-cells quadrate, papillose, 9–11 x 9–11 μ, median basal leaf-cells colored, rectangular, 11 x 17–45 μ, with some small cells 6–7 x 16–22 μ, marginal basal leaf-cells hyaline for 5–7 cells in toward the costa, decreasing up the margin to 1–2 cells above, ⅓–½ the way up, forming a distinct hyaline band, lower cells 5–16 x 40–50 μ, upper marginal cells 6 x 25 μ.* Dioicous; *perichaetia lateral*, perichaetial leaves long, 4.5 mm., acuminate from a wide, sheathing, undulate base, narrowing to a long point, with a long, excurrent costa, more hyaline cells at the base, colored cells extending up and almost touching the margin, almost to the serrulate, papillose tip, papillose cells fewer in number; seta red below to paler above, 2.5–3 cm. long; capsule long, urn 3–4 mm. long, cylindrical-oblong, straight or inclined, dark red when mature; operculum rostrate about 1 mm. long; peristome of 32 long, red, filiform, papillose teeth, twisted once or twice; spores maturing in spring, 11–14 μ, yellow, finely papillose. Type locality, the Tirol.

Illustrations:—Limp. l. c. *f. 176;* Braith. Brit. Moss Fl. **1**: *pl. 33D*, 1887; Dix. Handb. Brit. Mosses (Ed. 3), *pl. 30E;* Broth. Eng. & Prantl, Musci (Ed. 1) 398, *f. 254;* Bry. Eur. l. c.; *Pl. 81.*

Exsiccati:—Bauer, Musci Europ. et Amer. 1822; Bartram, Mosses of Ariz. 30, Mosses of Pima Co. Ariz. 329; Holz. Musc. Acro. Bor. Amer. 495; Bush, Mosses of Missouri, 151, 181, 186.

On rocky ledges, on ground, on sandy and stony shores, banks often near the shore, calcareous fields; especially in cedar barrens. Rare and usually sterile in North America. Arizona, New Mexico, Missouri, Tennessee, Texas, Virginia.

This plant will not readily be confused with any other, since the band of hyaline cells will serve as a means of identification. Only one species of *Pleurochaete* has so far been found in North America, north of Mexico.

*10. TORTELLA (C. Müll.) Limpr. Laubm. **1**: 599. 1890.

By Mrs. Inez M. Haring, M.A.

Barbula Sectio *Tortuosae* Bry. Eur. fasc. 13–15, 1842 et fasc. 31, Suppl. 1. 1846.
Barbula Sectio *Tortella* C. Müll. Syn. **1**: 599. 1849.
Tortula VI *Tortuosae* De Not, Musc. Ital. **1**. 1862.
Streblon Vent. in Comment. Fauna, Flora etc. Venezia No. 3. 1868.
Pleurochaete et Mollia A. *Tortella* Lindb. Musc. Scand. 21. 1879.

Plants erect, loosely to densely caespitose, chiefly in thick mats, usually cohering below by dense, felt-like brownish radicles; almost stemless to 1–8 cm. high, green to yellow-green above to brown below, sometimes shining due to the basal hyaline cells of the leaves; stems simple or branched, smooth, some with a central strand, mostly without; *leaves cirrhate-crispate* when dry, except *T. fragilis*, spreading to recurved when moist, *elongated-oblong to linear-lanceolate*, widest at or near the base, sometimes tapering to an acute apex, sometimes abruptly narrowing to a mucro point, sometimes cucullate, *with margins plane or involute*, sometimes undulate, sometimes crenulate, often both, sometimes concave, chlorophyllose in upper part only; perichaetial leaves sometimes slightly different; costa strong, ending in the apex or excurrent, sometimes denticulate, cross-sections with median guides and two stereid bands; upper leaf-cells roundish quadrate to hexagonal, papillose, *lower leaf-cells hyaline, rectangular, sharply differentiated, extending higher up the leaf at the margin than at the costa, abruptly passing into the chlorophyllose cells above, forming a more or less distinct V-shaped line.* Monoicous or dioicous; seta terminal, elongated, upright, red below to paler above; capsules upright or slightly bent, elliptical or cylindrical, smooth; peristome single, well developed, consisting of 32 more or less spirally twisted teeth which often appear joined in pairs at the base, long, red, filiform, papillose; no annulus; peristome from an inner basal membrane. Type species, *T. caespitosa.*

All our plants of the genus have until recently been included in *Barbula* by American authors.

On soil, especially in calcareous regions, sometimes in crevices and on rocks, base of trees, sometimes decaying wood. From Greenland, through Canada, northern United States, on down through the southern states.

One of the genera of mosses in which the leaf character plays an important part in the determination of species.

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KEY.

1. Leaves wide, soft, obtuse, some more or less cucullate. ..... 2.
   Leaves narrower, not cucullate, nor obtuse, more or less acute, tapering to an acuminate point, sometimes very long; dioicous ..... 4.
2. Leaves lance-linear, very short, 1–2 mm., ⅕–¼ hyaline, not undulate, very concave, cucullate; stem with no central strand ..... *3. inclinatula.*
   Leaves lance-linear, longer, 1–5 mm. long, ¼–⅓ hyaline, more or less undulate, less cucullate; stem with central strand ..... 3.
3. Leaves long lance-linear, 1.5–4.5 mm. long, ¼–⅓ hyaline, sometimes somewhat undulate, obtusely acute, abruptly mucronate by the excurrent costa; stem with central strand of thin-walled small cells; monoicous ..... *1. caespitosa*
   Leaves lance-linear, shorter, 1–3.5 mm. long, ¼–⅓ hyaline, quickly narrowed to an obtuse point, often subcucullate, undulate, concave; stem with central strand of thin-walled, larger cells; dioicous ..... *2. flavovirens.*
4. Leaves rather rigid, more or less broken off, fragile ..... 5.
   Leaves flexuose, less fragile, long, narrowing from base to a whip-like, acuminate apex, twisted crispate when dry ..... *4. tortuosa.*
5. Leaves with long, narrow points, tapering abruptly, scarcely curled at tip, straight below when dry, leaves erecto-patent when moist, often involute at tip. Leaves broken off in all but very young; stem without central strand ..... *6. fragilis.*
   Leaves shorter, with rather short points, usually strongly curled when dry, somewhat fragile, but not as many broken; stem with central strand ..... *5. nitida.*

1. TORTELLA ~~CAESPITOSA~~ (Schwaegr.) Limpr., Laubm. **1**: 600. 1890.

Barbula caespitosa Schwaegr. Suppl. **1**: 120, *pl. 31.* 1811.
Tortula caespitosa Hook. et Grev. in Brewster Edinb. Journ. **1**: 301. 1824.
Tortula Northiana Grev. in Trans. of the Linn. Soc. **15**²: 342, *pl. 3, f. 4.* 1827.
Barbula cirrata Bruch, in Fr. Müll. M. Sard. 1829.
Barbula intermedia De Not, Syll. 181. 1838.
Tortula humilis Lindb. de Tort. 251. 1864.
Mollia caespitosa Broth. Enum. M. Caucas. 48. 1892.

Plants in loose to dense tufts, almost stemless to 1.3 cm. high, green to yellow-green above to brown below, radiculose at base with brown radicles; stems erect, having a central strand, usually simple, sometimes branched; leaves crisped when dry, flexuose, erect-spreading, patent when moist, crowded, lance-linear to *oblong-lanceolate*, acuminate to obtusely mucronate, concave, 1.5–4.5 mm. long; costa yellow, sometimes denticulate, *excurrent in a mucro point* or acuminate; margins entire, crenulate, sometimes undulate, sometimes incurved above; upper leaf-cells papillose, quadrate for ⅔–¾, 7–8 x 8–9 μ, lower leaf-cells hyaline, rectangular, *extending obliquely higher up the margin than at the costa, 9–12 x 25–100 μ, abruptly becoming small and chlorophyllose, terminating in a V-shaped line.* Monoicous; perichaetial leaves wide, 2–5 mm. long, sheathing at the base, often narrowly pointed, sometimes mucronate, erect, usually more hyaline and with fewer papillose cells; *antheridia axillary, in short, pedicellate buds of 2–6 leaves*, 0.4–0.7 mm. long by 0–2.0.3 mm. wide, usually more hyaline, enclosing the antheridia; seta red below to pale yellow-green above, sometimes twisted when dry, about 1.5 cm. long; capsule oblong-cylindrical, light brown to red-brown, sometimes more or less incurved, 1.5–6. mm. long; operculum long, conic-rostrate; calyptra long, usually covering about half the capsule, sometimes all; annulus none; peristome from an inner basal membrane, teeth long, red, filiform, papillose, twisted usually two or three times; spores 7–10 μ, greenish, translucent, smooth, maturing in spring. Type locality, Pennsylvania.

ILLUSTRATIONS:—M. H. M. *pl. 32;* Jennings, Mosses of W. Penn., *pl. 13;* Bry. Eur. *pl. 149;* Braithw. Brit. Moss Fl. **1**: *pl. 37C.*

EXSICCATI:—Sull. Musci Allegh. 150; Sull. & Lesq. Musc. Bor. Am. 97 (Ed. 1), 136 (Ed. 2); Drumm. Musc. Am. S. States, 65; Holz. Musc. Acro. Bor.-Am. 60, 60b; Macoun Can. Fl. 299, Can. Mosses, 68, Fl. Canadensis 2091; Grout, Musci Perf. 217; Ren. & Card. Musc. Am. Sept. 25, Austin, Musci Appalachiani, 127.

On rocks, base of trees, decaying wood and soil in woods, often in calcareous regions. Canada, south through northern United States, to the Gulf and Arizona.

This species might be confused with *Barbula unguiculata* (Huds.) Hedw. but the leaves are longer than in that species, the margins are incurved and the hyaline cells run obliquely to the margin, which is not true in *B. unguiculata*. The leaves are very variable, some being decidedly acuminate, while more are abruptly mucronate. From *T. flavovirens* and *T. inclinatula* in the fertile plant it may be distinguished in that it is monoicous, while both of the others are dioicous. The leaves of *T. caespitosa* are longer and less concave than in either of the others, and the apex is seldom cucullate.

2. Tortella flavovirens (Bruch) Broth. Engler & Prantl, Musci, (Ed. 2) **1**: 263. 1924.

Trichostomum flavovirens Bruch, in Flora, **12**: 404, *pl. 2, f. 7*. 1829.
Didymodon tricolor Bals. et De Not. in Mem. Acad. d. Torino, **11**: 333. 1838.
Tortula flavovirens Lindb. de Tort. 252. 1864.
Mollia flavovirens Lindb. Musci Scand. 21. 1879.
Barbula flavovirens Kindb. Eur. & N. Amer. Bryin. 254. 1897.

Plants in loose to dense tufts, 0.3–1.5 cm. high, yellow-green above to yellow-brown below, somewhat radiculose below with brown radicles; stems erect, sometimes branched, having a central strand; leaves crisped, with the *costa distinct, shining and the hyaline cells standing out strongly when dry*, sub-erect to spreading when moist, crowded at the tip with the *lower leaves usually shorter, all erect, distant*, oblong-lanceolate from a sheathing base, *concave, quickly narrowed to an obtuse point, usually sub-cucullate*, sometimes almost linear-lanceolate, 1–3.3 mm. long; costa yellow, stout, excurrent, sometimes mucronate in a short point; margins entire, somewhat undulate, usually *involute, especially at the apex;* upper leaf-cells papillose ⅔–¾, quadrate to hexagonal, 9–13 x 11–13 μ, lower leaf-cells hyaline, thin-walled, rectangular, *extending obliquely higher up the margin than at the costa, abruptly becoming smaller and chlorophyllose, terminating in a V-shaped line*, 9 x 60–100 μ. Dioicous; perichaetial leaves longer, 3.5–4.5 mm., slightly more hyaline; seta 1–1.5 cm. long, red below to paler above, sometimes twisted when dry; capsule oblong-elliptic, erect; operculum conic-rostrate, slightly inclined; annulus none, peristome from an inner basal membrane, teeth long, red, filiform, papillose, sometimes slightly twisted, sometimes straight; spores mature in spring, 10–12 μ, golden brown, papillose. Type locality, European.

Illustrations:—Braith. Brit. Moss. Fl. **1**: *pl. 36D;* Dix. Handb. Brit. Mosses (Ed. 3) *pl. 29L;* Bry. Eur. *pl. 172; Pl. 82.* 78

Exsiccati:—Holz. Musc. Acro. Bor. Am., 274; Compton, Subtropical Florida, no number; Austin, Musci Appalachiani, Suppl. 492; also Haring, Fort Marion, Fla. 65.

Sandy soil and banks near the sea, often on coquina. North Carolina, Florida, Texas,—southern United States.

This species might be confused with *T. caespitosa* when sterile. The leaves of *T. flavovirens* are usually shorter, and the lower leaves smaller and farther apart than in *T. caespitosa*. The papillose leaf-cells of *T. flavovirens* are larger than those of *T. caespitosa*. The margins of *T. flavovirens* are usually more involute and more undulate than *T. caespitosa*, but all these characteristics are more or less variable which makes distinction more difficult. The apex of *T. flavovirens* is often subcucullate while that of *T. caespitosa* is not. When fertile *T. flavovirens* can be distinguished from *T. caespitosa*, in that the former is dioicous while the latter is monoicous. From *T. inclinatula* it may be distinguished in that the leaves are longer than in *T. inclinatula* and the apex of the latter is usually distinctly cucullate. The perichaetial leaves of *T. inclinatula* are as a rule much more hyaline than in *T. flavovirens*. *T. flavovirens* is found in southern United States while *T. inclinatula* is found in the north, Canada.

3. Tortella inclinatula (C. Müll. & Kindb.) Broth. Engler & Prantl, Musci (Ed. 1) 397. 1909.

Barbula inclinatula C. M. & Kindb. in Macoun Cat. 50. 1892.

Plants in more or less dense tufts, almost stemless to 1 cm. high, yellow-green above to brown-green below, radiculose with brown radicles; stems erect, seldom branched, having no central strand; leaves cirrhate-crisped when dry, sub-erect when moist, crowded especially at the tip, *not undulate*, sublinear to ovate-lanceolate, usually narrowing abruptly to a point, sometimes to an acuminate apex, concave, from a thin ovate-oblong base, *usually cucullate*, 1.5–5 mm. long; costa yellow, *with a tendency to become red at and near the base in the mature leaves*, pellucid, thick, excurrent in a short, sometimes denticulate point; margins involute, usually cucullate above, entire, crenulate, with papillae sometimes very low; upper leaf-cells usually densely papillose, sometimes appearing less so due to the lowness of the papillae, sometimes with

fewer papillae, *rounded-hexagonal, thick-walled, large, giving a honey-comb appearance to the cells as a whole,* 11–13 x 11–15 μ, lower leaf-cells hyaline for ⅕–¼ only, *extending obliquely higher up the margin than at the costa, abruptly becoming small and chlorophyllose, terminating in a V-shaped line,* rectangular, sometimes shorter and wider than most species, 11–16 x 50–60 μ; the perichaetial leaves much longer 2–5.5 mm. long, wider at the base, made up mostly of long narrow hyaline cells, long-linear to a long point, sometimes involute, and sometimes shorter, from a sheathing base, *only slightly curled when dry, very distinct, standing out strongly due to the long, hyaline portion.* Dioicous; seta long, 1.–2. cm., red below to paler above, sometimes twisted when dry; capsule narrowly cylindrical, nearly straight, suberect; operculum about half the capsule length; calyptra covering the capsule, cucullate; annulus none; peristome from an inner basal membrane, teeth long, red, filiform, papillose, and several times twisted; spores mature in spring. Type locality, Canada.

ILLUSTRATION:—*Pl. 84.*

EXSICCATI:—Macoun, Canadian Musci, n. sp.; Macoun, Canadian Mosses 70, 512; National Museum of Canada 105 Ont., 114 Alta.; Ontario, Moxley.

On earth and gravel on bars along old channels, also sand along shore of lakes. Canada.

This species is said to be like the European *Barbula inclinata* (Hedw. f.). From *T. caespitosa* in the fertile form, it can be distinguished by being dioicous. In the sterile form, *T. caespitosa* usually has an undulate margin, whereas *T. inclinatula* has not. *T. caespitosa* as a rule has longer leaves, which are less concave. *T. caespitosa* has about ¼–⅓ hyaline, whereas *T. inclinatula* has ⅕–¼. The stem of *T. caespitosa* has a central strand, whereas *T. inclinatula* has none. The apex of *T. caespitosa* is seldom cucullate, while that of *T. inclinatula* is usually so. From *T. flavovirens* it can be distinguished by its usually shorter leaves, with the more distinctly cucullate apex and by the shorter, wider, hyaline cells in the gametophyte, and by the perichaetial leaves, which in *T. inclinatula* are mostly hyaline, much more than *T. flavovirens. T. inclinatula* is found in the northern part of our range, while *T. flavovirens* is found in the southern part.

4. TORTELLA TORTUOSA (L. Turn.) Limpr. Laubm. **1**: 604. 1890.

Tortula tortuosa Turn. Musc. Hib. 52. 1804.
Tortula incrassata Brid. Sp. Musc. **1**: 264. 1806.
Barbula tortuosa W. & M. Bot. Taschb. 205. 1807.
Barbula tortuosa var. *incrassata* Brid. Bryol. Univ. **1**: 57. 1826.
Mollia tortuosa Lindb. Musc. Scand. 21. 1879.
Trichostomum tortuosum Dix. Handb. Brit. Mosses (Ed. 1), 221. 1896.
Barbulosa subtortuosa C. Muell. in Nuov. Giorn. Bot. Ital. 100. 1896.

Plants in large or small, more or less *dense, rounded tufts,* 1.–7. cm. high, green to yellow-green above, red-brown to dark brown below, radiculose with dense red-brown radicles; stems robust, erect, sometimes branched, *with no central strand;* leaves crowded, *crisped and strongly twisted when dry,* spreading and flexuose when moist, *linear-lanceolate, gradually narrowing from the base to a slenderly acute apex at the tip, very long, 2.–6.5 mm.;* costa thick, *excurrent to a long or short acute point,* which is sometimes denticulate above; *margins undulate, flat, crenulate-papillose above;* upper leaf-cells strongly papillose, ovate-quadrate, for upper ⅔–¾, 9–11 μ, lower leaf-cells hyaline, rectangular, *extending obliquely higher up the margin than at the costa, abruptly becoming small and chlorophyllose, terminating in a V-shaped line,* 7–9 x 45–80 μ. Dioicous; perichaetial leaves long, 5–5.5 mm., more hyaline, often to ½, erect, somewhat sheathing, upper part sometimes mostly costa; seta 1.7–3 cm. long, *red below to paler above,* often twisted when dry, archegonia usually present at the base; capsule shortly or longly cylindrical, yellow to red-brown, straight to slightly arcuate, 2.5–3.5 mm. long; operculum rostrate, sometimes nearly as long as the capsule, sometimes much shorter; annulus none, peristome from a narrow basal membrane, teeth long, red, filiform, papillose, twisted 2–3 times, not much joined at the base; spores mature in late spring and summer, 8–12 μ, yellow-green, finely papillose. Type locality, the Alps.

ILLUSTRATIONS:—Braith. Brit. Moss Fl. **1**: *pl. 27C;* Broth. Engler & Prantl, Musci, (Ed. 1) 1909, 388, *f. 244 A–D;* Dix. Handb. Brit. Mosses (Ed. 3) *pl. 30C;* M. H. M. *f. 73.*

EXSICCATI:—Drum. Musc. Am. 141; Sull. Musci Allegh. 148; Sull. & Lesq. Musc. Bor. Amer. 97b (Ed. 1), 137 (Ed. 2); Austin Musc. Appal. 128, Suppl. 492; Macoun, Canadian Mosses 78, Canadian Cryptograms 561, Canadian Musci 464, Flora Canadensis 89; Ren. & Card. Musc. Am. Sept. Exsic. 284; Grout, Musci Perfecti 65; Holz. Musc. Acro. Bor. Am. 182; Allen, Mosses of the Cascade Mts. 18.

Common on rocks and mountain slopes, principally in calcareous regions, sometimes on soil, sometimes in moist crevices. Seldom fruiting. Greenland, Canada, northern United States, south to the Gulf,—almost worldwide in its distribution.

This is the most common species of the family except *Weisia viridula*. The large size of the plants, the long, linear-lanceolate, slenderly acuminate leaves, much crisped and spirally twisted when dry, makes this species easy of identification. There is, however, much variation in the height of the stem and the length of the leaves. *Tortella nitida* might be confused with it and these two seem very closely related. *T. nitida* is not as robust and the leaves as a rule, curl in circles and not in a corkscrew fashion as in *T. tortuosa*. The leaves of *T. nitida* do not have the long, whip-like apex of *T. tortuosa*.

5. TORTELLA NITIDA (Lindb.) Broth. Engler & Prantl, Musci, (Ed. 2) **1**: 263. 1924.

Tortula nitida Lindb. de Tort. 252. 1864.
Barbula alexandrina Lor. in Abh. d. Akad. Wissensch, Berlin, 32–35, *pl. 6, 7*. 1867.
Trichostomum Barbula (non Schwaegr.) Lange, in Bot. Tids. **2**: 235. 1868.
Trichostomum diffractum Mitt. Journ. of Bot. 98, *pl. 77, f. 5, 6*. 1868.
Barbula inclinata β *nitida* Mol. Bay. Laubm. 97. 1875.
Trichostomum circinans Schimp. Syn. (Ed. 2) 179. 1876.
Trichostomum nitidum (Lindb.) Schimp. Syn. (Ed. 2) 179. 1876.
Barbula nitida Jur. 1867 & Laubmfl. v. Oesterr., ung. 121. 1882.
Barbula tortuosa var. *nitida* Ren. in Rev. Bryol. **9**: 90. 1882.
Mollia nitida Lindb. Braith. Brit. Moss Fl. **1**: 250, *pl. 37A*. 1887.

Plants in dense, even tufts, 1.7–3 cm. high, dark to light yellow-green above to somewhat brown below, radiculose below with brown radicles; stems erect, sometimes branching, *having a central strand; leaves crisped in circles at tip, less crisped below, closely incumbent when dry*, suberect when moist, slightly undulate, crowded, linear-lanceolate, *tapering to a shortly acuminate apex*, 2.–7. mm. long, *very fragile*, usually with some leaves broken off; costa thick, excurrent, sometimes denticulate, *shining and glossy at back when dry;* margins plain, crenulate, usually undulate; upper leaf-cells papillose for ⅔–¾, quadrate, 11–13 x 11–17 μ, lower leaf-cells hyaline, rectangular, *extending obliquely higher up the margin than at the costa, abruptly becoming small and chlorophyllose, terminating in a V-shaped line*, 11–14 x 60–100 μ. Dioicous; perichaetial leaves small, lanceolate-subulate with excurrent costa; seta red below to paler above, 5.–8. mm. long; capsule oblong-cylindrical, pale brown, slightly furrowed when mature; operculum ⅓ the length of the capsule, obliquely rostrate; annulus indistinct, peristome short, of rather imperfect, very slightly oblique, yellowish, papillose teeth. Type locality, near Gibraltar.

ILLUSTRATIONS:—Braith. Brit. Moss Fl. **1**: *pl. 37A*, 1887; Dix. Handb. Brit. Mosses (Ed. 3) *pl. 30B; Pl. 81*.

EXSICCATI:—Macoun, Canadian Musci, 605; Herb. N. Y. Bot. Gard., Montana, Williams, 329; House, specimen from Harris Lake, N. Y.

On earth, rocks, and walls, especially calcareous, along lakes. Rare and seldom fruiting. Southern Canada and northern United States.

Tortella nitida is very closely allied to *T. tortuosa*. In the fertile form they may be distinguished in that the peristome of *T. nitida* is much less twisted than that of *T. tortuosa*. In the sterile form they are more difficult to distinguish. *T. nitida* is less robust than *T. tortuosa* but is more rigid, hence the cushions of *T. nitida* have a more even, erect, smooth appearance. Braithwaite says, "Some botanists have been disposed to refer this moss to *Mollia tortuosa*, but they are quite distinct, and the glossy, stiff, little cushions of *M. nitida* have an aspect so peculiar that it may always be identified by the naked eye alone." The leaves of *T. nitida* when dry, mostly curl in circles at the tip, whereas those of *T. tortuosa* curl spirally like a cork-screw. The lower leaves of *T. nitida* when dry, are usually less crisped and more incumbent than in *T. tortuosa*. The costa of *T. nitida* is also much more shiny and glossy when dry than that of *T. tortuosa* and there are usually a number of broken leaves which will help in identification. The leaves of *T. nitida* are more fragile than those of *T. tortuosa*.

6. TORTELLA FRAGILIS (Hook. & Wils.) Limpr. Laubm. **1**: 606. 1890.

Didymodon fragilis Hook. f. & Wils. in Drumm. Musc. Am. No. 127. 1828.
Tortula fragilis Wils. in Hook. Journ. Bot. **3**: 437. 1841.
Trichostomum fragile C. M. Syn. **1**: 586. 1849.
Campylopus Hartmanni Schimp. mss.; Hartm. in Nya Bot. Not. 49. 1855.
Barbula fragilis Bry. Eur. fasc. 62–64, Suppl. *pl. 4*. 1855.
Tortula Drummondii Mitt. Journ. Linn. Soc. **1**: Suppl. 27. 1859.
Barbula Drummondii Milde, Bryol. Siles 124. 1869.
Mollia fragilis Lindb. M. Scand. 21. 1879.
Trichostomum lonchobasis C. Muell. in Nuov. Giorn Bot. Ital., 102. 1896.

In dense tufts, almost stemless to 6.2 cm. high, yellow-green above, *usually changing abruptly to brown below, showing a distinct band of green above*, densely radiculose below with brown radicles; stems erect, usually branched, no central strand; *leaves rarely crisped to any extent*, sometimes slightly curled especially at the tip, *close and straight below, very glossy and shiny at back, erect when dry, erecto-patent, mostly straight, when moist*, obovate-lanceolate at base, *tapering abruptly to an acuminate, long tip, composed mostly of costa at the apex, very fragile and broken off in all but the younger leaves*, 2.8–6.5 mm. long; costa yellowish, sometimes denticulate, excurrent in a short point; margins not undulate, often somewhat involute above; upper leaf-cells densely papillose, very chlorophyllose, quadrate, 7–11 μ; lower leaf-cells hyaline, rectangular, *extending higher up the margin than at the costa, abruptly becoming small and chlorophyllose, terminating in a V-shaped line*, 9–11 x 45–100 μ. Dioicous; perichaetial leaves longer, much more hyaline, broken off, sheathing, with a strong costa, 5–7 mm. long; seta red below to pale yellow above, 1.4–2.5 cm. long; capsule ovate-oblong to cylindrical, straight or slightly curved, 2–3 mm. long; operculum oblique, long-beaked from a conical base; annulus none, peristome from an inner basal membrane, teeth long, red, filiform, papillose, twisted two or three times; spores mature in summer, 8–10 μ, yellow-green, smooth. Type locality, North America.

Illustrations:—Braith. Brit. Moss Fl. **1**: *pl. 27D;* Dix. Handb. Brit. Mosses (Ed. 3) *pl. 30D;* Bry. Eur. *pl. 639;* M. H. M. *pl. 31.*

Exsiccati:—Drumm. Musc. Am. 127; Sull. & Lesq. Musc. Bor. Am. 101, 149; Austin, Musci Appal. 129; Macoun, Can. Musci 69; Ren. & Card. Musc. Am. Sept. 216; Holz. Musc. Acro. Bor. Am. 19; Allen, Mosses Cascade Mts. 19; MacFadden, N. A. Fl. 715, 744; Cox & O'Neill, Plants from Can. Arctic Exp. Field number 28b, 1913–1916; Williams, Plants of the Yukon Terr. 574; Bauer, Musc. Eur. & Am. 2161a.

On sand or rocks, often near lakes or streams. Seldom fruiting. In the more northern part of North America, south to New Jersey, and Missouri.

Tortella fragilis might be confused with *T. tortuosa* and *T. nitida*. The leaves of *T. fragilis* are only slightly curled at the tip, and mostly straight below when dry, while those of *T. tortuosa* and *T. nitida* are crisped. When moist the leaves of *T. fragilis* are erecto-patent and mostly straight, with the abrupt narrowing to a long apex, almost all costa, which is not true of the other two species. The leaves of *T. fragilis* are much more brittle than *T. tortuosa*, and more brittle than *T. nitida*, thus there will usually be many more leaves broken off in *T. fragilis* than in either of the other. Sometimes, however, it may be difficult to distinguish *T. fragilis* and *T. nitida* by this characteristic only, but it will be noticed that in *T. fragilis* the leaves are all broken straight across through the costa, while in *T. nitida* there is a tendency for the costa not to break. This is not a constant difference.

11. TRIQUETRELLA C. Muell. Oesterr. Bot. Zeitschr. 420. 1897.

Plants slender, in thick loose mats; stems without central strand, variously branching; leaves not crowded, somewhat appressed when dry, when moist squarrose spreading, keeled, decurrent, oblong to ovate at base, acuminate and acute; margins entire, recurved to above the middle; costa percurrent or nearly so, papillose on both faces; leaf cells rounded, chlorophyllose, papillose on both sides with high sharp papillae, sometimes 2-pointed, nearly uniform throughout except at the very insertion and in the decurrent angles; perichaetial leaves half-sheathing; seta long. Capsules cylindric, smooth; annulus present; peristome inserted below the mouth, sometimes with a preperistome, teeth 16, short, slender, hyaline, weakly jointed, sometimes perforate or irregular; operculum conic-rostrate. Type species, *T. tristicha* C. Muell.

The name was evidently given because the stem is supposed to be obtusely 3-angled, but Lesquereux described our species as having the leaves "four-ranked."

Triquetrella californica (Lesq.) Grout, Moss Fl. **3**: 201. 1934.

Anomodon californicus Lesq. Mem. Calif. Acad. **1**: 30. 1868.

Secondary stems simple or branching by innovations; leaves ovate, rather gradually acuminate and acute, strongly decurrent at the auriculate angles; margins widely recurved to near the apex; leaf cells rounded, nearly isodiametric, thick-walled, with a high sharp-pointed papilla on each surface, 7–10 μ in diameter. Sporophyte unknown. Type locality, Monte Diablo, California (*Bolander*). The only known collection. *Pl. 83.*

The leaf cells in the decurrent auricles are somewhat elongated, but are usually left on the stem when the leaves are stripped, but on the specimens studied (from the type locality and collector and probably co-type), there were the large papillae only on the auricles, not ciliate as described in the Lesq. & James Manual, 397. The basal cells were not noticeably different from the median.

12. LEPTODONTIUM Hampe, Linnaea **20**: 70. 1847.

Loosely tufted soft mosses that resemble *Zygodon* in the structure of their gametophyte and in the presence of similar brood bodies in some species; stems without central strand; leaves squarrose-spreading when moist from a more or less erect base, keeled, crisped when dry, broadly oblong-lanceolate to lingulate, acute or apiculate at apex; margins revolute at base, coarsely and irregularly toothed above; costa ending below apex in our species, with 2–4 median guides and a dorsal stereid band only; lamina unistratose, with basal cells rectangular, hyaline or colored, mostly smooth, gradually merging into the smaller, chlorophyllose upper cells, which are densely papillose on both sides. Dioicous; capsule long exserted, cylindric, a little larger at base, smooth; annulus present, deciduous; peristome teeth 16, smooth or nearly so, short and slender, often irregularly anastamosing. Type species, *L. squarrosum* (Hook.) Paris.

The costa has the structure of the *Pottieae* but otherwise the relationship seems close to *Didymodon*.

Key.

Leaves oblong-lingulate ..... *1. flexifolium.*
Leaves narrowly oblong-lanceolate ..... *2. excelsum.*

1. Leptodontium flexifolium (Sm.) Hampe, Linnaea l. c.

Trichostomum flexifolium Sm. Fl. Brit. 1246. 1804.
Didymodon flexifolius Hook. & Tayl. Musc. Br. 66. *pl. 20.* 1818.

Plants in wide loose mats reaching an inch or more in height in sterile plants, fertile about half as high; stems usually branched; leaves rather distant, decurrent, 1–1.5 mm. long, oblong-lingulate, abruptly and sharply acute, unistratose, keeled, squarrose-recurved when moist, more erect and crisped when dry, margin recurved below, strongly and irregularly toothed above; costa narrow, ending below the apex, papillose on the back above, in section with about two large guides and *only a dorsal* stereid band; leaf cells as described for the genus, upper rounded-quadrate or hexagonal, 10–14 μ in diameter, papillae rather low and occasionally with two points; perichaetial leaves longer, sheathing about half way, seta slender, up to 2 cm. long; capsule narrowly cylindric, narrower above, darker at the mouth, somewhat wrinkled when dry and empty; operculum long-conic; annulus wide; peristome teeth slender pale, smooth, yellowish, without basal membrane, often somewhat irregularly anastomosing; spores smooth, about 10 μ, mature in early spring.

Illustrations:—Bry. Eur. *pl. 188;* Braithw. Brit. Moss Fl. **1**: *pl. 37E;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 28D;* Limpr. Laubm. **1**: 563, *f. 163*.

1a. Var. americanum (Grout) **n. comb.**

Zygodon gracilis var. *americanum* Grout, Moss Fl. N. Am. **2**: 141. *pl. 62D.* 1935.
Leptodontium Orcutti Bartr. Jour. Wash. Acad. Sci. **21**: No. 13. 289. 1931.

This American form has the costa structure of the species; it seems to differ only in the more numerous larger and more plainly forked multiple papillae, which make the leaf cells more obscure and in the marginal papillae more numerous and conspicuous, many of the papillae are simple; the peristome teeth are a little irregular on the margin in the Costa Rican plants. Type from ledges, Chestnut Bald, N. Carolina, Alt. 6000 ft. Also collected on Grandfather Mt., N. Carolina, by Anderson and Sharp; all sterile. The Mexican and Costa Rican plants named *L. Orcutti* by Bartram were fruiting. Both have been examined through the courtesy of Mr. Bartram. Some of the American plants have some leaves with a lighter border as mentioned by Dixon, l. c. p. 221. The variety only is known from N. America.

Illustration:—Grout, l. c.
Exsiccati:—Holz. Musc. Acro. Bor. Am. 264 (as *L. flexifolium;* see Bryol. **13**: 84. 1910).

2. Leptodontium excelsum (Sull.) E. G. Britton, Bryol. **11**: 66. 1908.

Syrrhopodon? excelsus Sull. Musc. Allegh. 170. 1848.
Zygodon Sullivantii C. Muell. Syn. **1**: 679. 1849.
Amphoridium Sullivantii (C. Muell.) Lesq. & James, Man. 159. 1884.
Zygodon excelsus E. G. Britton, Mem. Torr. Bot. Club. 4: 180. 1893, *not* of C. Muell. Linnaea, **42**: 369. 1878.

Plants in loose intricate mats or tufts, light green above, brown below; stems long and slender, up to 7 cm. long, usually shorter, flexuose, distantly foliate, radiculose, sparingly and irregularly branched, often with slender filiform innovations; leaves narrowly elongate-lanceolate, acuminate, usually ending in a single elongate cell, up to 2 mm. long, often radiculose at tip, longly and narrowly decurrent, squarrose when moist, more erect and twisted when dry, strongly carinate; margins entire and recurved below, plane and strongly and irregularly toothed above; costa rather narrow, not papillose at back, in cross section similar to the last; lower leaf cells elongate-rectangular to the costa, shorter at the margin, smooth, hyaline or colored, merging into the small, thick-walled upper cells, which are papillose on both sides with low blunt papillae, irregular and rounded, lumen 7–10 μ in longest dimension, often transversely elongated, especially at the margin; perichaetial leaves and aborted archegonia only seen. Type from rocks, Grandfather Mt., North Carolina (*Sullivant*).

Illustrations:—Sull. Icones Musc. *pl. 32* (the winged costa, *f. 13*, seems to be an error); *Pl. 85*.
Exsiccati:—Sull. Musc. Allegh. 170; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 114, (Ed. 2) 169.
On rocks, more frequently on twigs of conifers, high mountains of North Carolina, Georgia, Tennessee and Virginia.
Near *L. brevisetum* from Mexico, which differs in being stouter, leaves more squarrose and with different leaf cells.

13. HYOPHILA Brid. Bryol. Univ. **1**: 760. 1826.

Rottleria Brid. l. c. 105 (not Willd. 1797).
Pottia section *Hyophila* C. Muell. Syn. **1**: 558. 1849.
Weisia section *Hyophila* Mitt. Jour. Linn. Soc. **12**: 135. 1869.

Plants in low dark green tufts, brown with age; stems branching, central strand present; leaves crowded, more or less inrolled and curled when dry, spreading when moist, mostly clasping at base, spatulate to oblong or even linear-lanceolate, obtuse to acute, entire or serrate; costa ending below the apex or shortly excurrent, in cross section with a median row of guides and dorsal and ventral stereid bands; leaf cells smooth or papillose, the basal hyaline, rectangular and smooth, the upper small, rounded and usually papillose; perichaetial leaves smaller or not differentiated. Dioicous; seta long-exserted, slender, erect; capsule narrowly cylindric to ovoid; annulus present, deciduous; operculum conic to rostrate, with cells not in spirals; calyptra cucullate; peristome absent, in our species, rudimentary when present.

Hyophila tortula (Schwaegr.) Hampe, Bot. Zeit. **1846**: 267. 1846.

Gymnostomum tortula Schwaegr. Suppl. **2**^{2}: 78. *pl.* 175. 1827.
Hyophila riparia (Aust.) Fleisch. Ms., E. G. Britton, Bryol. **7**: 69. 1904.
Pottia riparia Aust. Musc. Appal. 112. 1870.
Trichostomum Warnstorfii Limpr. Laubm. **1**: 587. 1888.
Leptodontium canadense Kindb. in Macoun Cat. Can. Pl. **6**: 45. 1892.
Leptodontium riparium E. G. Britton, Bull. Torr. Club, **19**: 275. 1892.
Didymodon riparius Kindb. Eu. & N. Am. Bryin. 280. 1897.

Plants up to 3 cm. high, branching, leaves crowded $\pm$ 2 mm. long, lingulate, somewhat decurrent, obtuse and apiculate, nearly entire to coarsely serrate above, margins plane, incurved at the base; costa mostly on dorsal side of leaf, ending below apex or percurrent; basal cells rectangular, $\pm$ 12 x 27 μ, the upper nearly quadrate, 7–12 μ in diameter, slightly papillose, bulging mamillose ventrally, smooth dorsally; in the axils of the upper leaves and mixed with the archegonia are numerous polymorphous brood bodies as illustrated. Dioicous; seta 5–7 mm. long; capsule cylindric, about 1 mm. long; annulus large. Type locality, Cuba.

Illustrations:—Sull. Icones Musc. Suppl. *pl. 21;* Limpr. Laubm. **1**: *figs. 170, 171; Pl. 85*.
Exsiccati:—Aust. l. c.; Holz. Musc. Acro. Bor. Am. 468; 513; Bartram, Mosses S. Arizona 100.
Sporophytes from N. America reported but once by Austin in New Jersey.
On moist shaded rocks, New York, New Jersey, Pennsylvania, Ohio, Tennessee, Arizona, Florida; Owen Sound, Ontario; also in central Europe; W. Indies to Brazil.
The costa in some leaves clearly ends below the leaf apex, in others it seems to be shortly excurrent into the apiculus, both on the same plant. The great variations in the leaves are confusing, they may be

blunt, rounded and apiculate to broadly but sharply acute; nearly entire to coarsely serrate, lingulate or rather narrowly lanceolate.

Most American plants have leaves smooth on the back and costa not papillose at back, but specimens collected at Bashbish Falls, N. Y., have the costa rough on the back above. Husnot's Musc. Gall. 859 (*Trichostomum Warnstorfii*) has the cells mamillose at back and the costa papillose fully half way down, strongly so at apex. Limpricht describes it as smooth.

14. BARBULA Hedw. Fund. Hist. Nat. Musc. 2: 92. 1782; Sp. Musc. 115. 1801.

William Campbell Steere*

Plants small to medium sized, gregarious or more commonly densely caespitose, growing usually on calcareous soil or rocks, glaucous-, yellowish-, or brownish-green, often with a tinge of red; stems normally erect, simple or branching, either fasciculately or by means of terminal innovations; central strand of differentiated cells present or absent, not constant within most species; leaves linear-lanceolate to ovate-lingulate, never becoming wider above the base (with the exception of *B. agraria*), usually larger toward the apex of the stem, usually more or less contorted or crisped when dry, erect or erect-spreading to widely spreading or even squarrose when moist; margin entire, recurved or revolute, rarely plane, never incurved, of one layer of cells in thickness, or very rarely two; costa very well developed, from not quite percurrent to long-excurrent, almost generally showing in cross section 2–6 central guide cells and two stereid bands; cells of upper leaf blade very small, usually strongly papillose and obscure, thick-walled, rarely smooth and clear, or thin-walled; basal cells larger, smooth, thinner walled, isodiametric, short-rectangular, or rarely really elongated, very rarely much enlarged and hyaline.

Inflorescence dioicous; perichaetial leaves very slightly or not at all differentiated to strongly convolute-sheathing; seta elongated, straight, red or rarely yellow; usually twisted when dry; capsule always exserted, erect, rarely somewhat cernuous, short-ovate to long-cylindric, straight or somewhat curved, dark red or brown, rarely pale; calyptra long-beaked, cucullate, variable in length; operculum long-rostrate, rarely equalling the urn in length; annulus variable, revoluble and deciduous in very few species, persistent in most and then not of much taxonomic value; peristome inserted below the mouth on a low basal tube, peristome teeth 32, threadlike, papillose, red, wound spirally to the left from very slightly to several complete turns, free or rarely somewhat cancellate or trabeculate; spores very small, mostly smooth. Propagula of various sorts are not uncommon. Type species, *B. unguiculata* Hedw.

To this large genus Brotherus (in Engler u. Prantl, Ed. II) attributes some 300 species, of which fully half could easily be reduced to synonymy through careful study. That this is a reasonable supposition is well demonstrated by the present revision, in which the seventy-odd species which had been described or reported from our range are reduced to eighteen (not counting one new species). These nineteen species of *Barbula* fall into nine fairly natural and distinct groups (several of which are adopted from the Bryologia Europaea).

(1) *Convolutae*, containing *B. convoluta* and *B. eustegia*, which are characterized by the convolute-sheathing perichaetial leaves, the yellow seta, twisted to the right, and the revoluble annulus.

(2) *Revolutae*, containing *B. spiralis* and *B. platyneura*, which have almost the whole lamina revolute in one or more complete turns.

(3) *Unguiculatae*, containing *B. unguiculata* and *B. Cruegeri*, characterized by the lingulate leaves, mucronate at the blunt apex by the short-excurrent, yellowish costa, which is strongly papillose on the back. The peristome teeth of this group tend to be somewhat cancellate or trabeculate.

(4) *Agrariae*, containing only *B. agraria* in our range. The leaves become broader above the base, the leaf margin is plane, the cells are nearly smooth, and the annulus is revoluble.

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(5) *Hydrogonium*, with *B. Ehrenbergii*, which has flaccid, only slightly papillose leaves, with plane margins, and usually grows in wet places or actually in the water. The plants are often heavily encrusted with calcareous deposits.

(6) *Fallaces*, containing *B. fallax*, *B. reflexa*, and *B. michiganensis*, characterized by widely spreading leaves, linear cells composing the dorsal surface of the costa, the uniform, very thick-walled cells of the lamina, and the dark, clear red peristome teeth.

(7) *Acutae*, containing *B. acuta*, *B. Bescherellei*, *B. icmadophila*, and *B. Johansenii*, characterized by the conspicuously excurrent costa and smooth or only slightly papillose leaf cells.

(8) *Rubiginosae*, containing only *B. rubiginosa*, which has a remarkably uniform areolation, the basal cells not at all elongated, or even wider than long, and no trace of a peristome.

(9) *Vineales*, containing *B. brachyphylla*, *B. vinealis*, and *B. cylindrica*, which have isodiametric cells on the ventral surface of the costa, and a dusty-red peristome which fades with age.

Key.

1.	Leaves oblong, ligulate or lingulate, usually obtuse or obtusely acute at the apex; costa usually slightly excurrent as a pellucid mucro; leaf margin plane to strongly recurved	2.
	Leaves lanceolate or subulate, tapering gradually from an ovate or oblong base to a definitely acute apex; costa never mucronate; leaf margin always recurved	9.
2.	Perichaetial leaves conspicuously convolute; seta bright yellow, twisted to the left when dry	3.
	Perichaetial leaves not convolute; seta red, twisted to the right when dry	4.
3.	Inner perichaetial leaves truncate to obtusely acute; costa excurrent as a mucro in some stem leaves	*1. convoluta.*
	Inner perichaetial leaves acute or acuminate, with a long, papillose apiculus	*2. eustegia.*
4.	Margins widely revolute from base to apex	5.
	Margins plane throughout or revolute only in the lower part, plane above	6.
5.	Basal leaf cells 2–3 times as long as wide	*3. spiralis.*
	Basal leaf cells quadrate to short-rectangular	*4. platyneura.*
6.	Upper leaf cells densely papillose, very obscure	7.
	Upper leaf cells smooth to very slightly papillose	8.
7.	Propagula always absent	*5. unguiculata.*
	Propagula almost always present; a coastal plain species	*6. Cruegeri.*
8.	Leaves widest at about the middle, narrower at the base; growing on dry limestone or soil	*7. agraria.*
	Leaves widest at the base, tapering gradually to the apex; growing on wet limestone or soil, sometimes in the water	*8. Ehrenbergii.*
9.	Cells of ventral (upper) surface of costa linear, very different from those of lamina.	10.
	Cells of ventral surface of costa quadrate, similar to those of lamina	12.
10.	Leaves widely spreading to squarrose; propagula absent	11.
	Leaves erect spreading, only the apex reflexed; axillary propagula numerous	*11. michiganensis.*
11.	Leaves strongly recurved to squarrose, reddish; papillae unusually long and sharp	*10. reflexa.*
	Leaves widely spreading, slightly recurved, brownish-green; papillae less conspicuous	*9. fallax.*
12.	Costa definitely and conspicuously excurrent; leaf cells usually not papillose at all.	13.
	Costa ending in or below the apex, rarely very slightly excurrent; leaf cells usually strongly papillose	16.
13.	Costa enlarged above, the excurrent part caducous; known only from the Canadian Arctic	*12. Johansenii.*
	Costa not enlarged above, the excurrent part never caducous	14.
14.	Costa very long-excurrent; leaves rather suddenly contracted from an ovate base to a subulate apex	*13. icmadophila.*
	Costa short-excurrent, leaves gradually tapered from base to apex	15.

15. Plants in short, dense tufts; capsule short, small ..... *14. acuta.*
Plants in loose, elongated tufts, capsule long-cylindric ..... *15. Bescherellei.*
16. Basal leaf cells quadrate or wider than long; peristome completely absent ..... *16. rubiginosa.*
Basal leaf cells short-rectangular to 2–3 times longer than wide; peristome always present ..... 17.
17. Leaves obtuse to obtusely acute; whole leaf margin recurved ..... *17. brachyphylla.*
Leaves sharply acute; leaf margin usually recurved only in the lower two-thirds or less, plane above ..... 18.
18. Leaves lanceolate, 1.5–2.5 mm. long, not flexuous; margin recurved to above the middle ..... *18. vinealis.*
Leaves linear-lanceolate, 2.5–5 mm. long, flexuous; margin recurved only at the base *19. cylindrica.*

1. BARBULA CONVOLUTA Hedw. Sp. Musc. 120. 1801.

Barbula chrysopoda C. Müll. & Kindb. Macoun Cat. Can. Pl. **6**: 57. 1892 (type seen).

Plants very small, in dense tufts, bright yellowish or glaucous green; stems short, rarely reaching 2 cm.; leaves erect-spreading, recurved when moist, imbricated, crispate and curled when dry, oblong-lanceolate or ligulate, apex obtuse, apiculate or rarely acute; margin only slightly reflexed at base, plane above, rarely plane throughout; costa strong, ending at or just below the apex, rarely very shortly excurrent as in *B. unguiculata;* basal cells long-rectangular, smooth, transparent, upper cells densely papillose, obscure, subquadrate; perichaetial leaves strongly and conspicuously convolute, truncate, short-apiculate or rarely obtusely acute, the innermost faintly costate or ecostate. Seta yellow, long, slender, twisted to the left when dry; capsule oblong to short-cylindric; operculum long-rostrate; annulus distinct, revoluble and deciduous; peristome bright red, much twisted. Type locality, Europe.

ILLUSTRATIONS:—Hedw. Stirp. Crypt. **1**: *pl. 32* (as *B. setacea*); Bry. Eur. *pl. 155;* DeNot. Musc. Ital., *pl. 25, figs. 1–20;* Braithw. Brit. Moss Fl. **1**: *pl. 41C;* Limpr. Laubm. *fig. 177;* Husnot, Musc. Gall. *pl. 30;* Roth, Eur. Laubm. *pl. 22, fig. 2, pl. 23, fig. 1;* Jennings, Mosses W. Pa., *pl. 13;* Dixon & Jam. Handb. Brit. Mosses (Ed. III) *pl. 28B;* Mönkem. Laubm. Eur. *fig. 60c;* Casares-Gil, Musgos, Fl. Ibér. *fig. 111, a–h;* M. H. M. *pl. 28.*

EXSICCATI:—Drummond, Musc. Amer. 138 (as *Tortula*); Sull. & Lesq. Musc. Bor. Am. (Ed. I) 98, (Ed. II) 138; Aust. Musc. Appal. 122, 126; Heller, Plants of Calif. 6485; Grout, Musci. Perf. 133; Macoun, Canad. Musci 76, 215, 216 (as *B. chrysopoda*), Canad. Mosses 77 (as *B. chrysopoda*), Canad. Crypt. 21 (as *B. chrysopoda*).

Growing on calcareous soil in fields, on banks and over rocks, but almost never on bare rock. Common and widely distributed throughout eastern North America from Nova Scotia to Florida, less common through the Central States, apparently lacking in the arid southwest and the greater part of the Rocky Mountains, but common and widespread on the Pacific Coast from Mexico to British Columbia.

Easily recognized when fruiting by the straw-colored seta and conspicuously sheathing-convolute perichaetial leaves, although in older fruiting specimens the many innovations often overgrow and hide the perichaetium. Sterile plants are apt to be confused with *B. unguiculata,* but may be distinguished by the shorter leaves which are less recurved or reflexed along the margins and the shorter costa, which is less apt to be excurrent into a cuspidate or mucronate point. In general, the American specimens have shorter, fewer, and consequently less conspicuous perichaetial leaves than the European specimens. On the other hand, the perichaetial leaves in American material possess a better developed costa.

2. BARBULA EUSTEGIA Card & Thér. Bot. Gaz. **30**: 17. 1900.

Barbula perannulata Williams, Bull. N. Y. Bot. Gard. **2**[7]: 358. 1902 (type seen).

Plants small, gregarious to densely caespitose, yellowish-green; stems very short, rarely reaching 1 cm.; leaves contorted when dry, spreading to slightly recurved when moist, linear-lanceolate, with an obtuse to obtusely acute apex; margins plane to slightly revolute; costa strong, reaching to or nearly to the apex, never excurrent, papillose on the dorsal side; basal cells pellucid, smooth, oblong to rectangular, the upper cells subquadrate, much smaller, obscure, minutely papillose; perichaetial leaves somewhat larger than the stem leaves, with a large, smooth, convolute-sheathing base and a papillose apiculus or broader apex as long as the base in the outer perichaetial leaves, inner perichaetial leaves costate, with a long, papillose apiculus, never truncate or even obtusely acute. Seta bright yellow, slender, 10–20 mm. long, twisted to the left when dry; capsule ovate-oblong, operculum very long-rostrate, often as long as the urn; annulus

large, of two or three rows of cells, revoluble, deciduous; peristome deep red, papillose, teeth about 1 mm. long, closely twisted, with a well developed basal membrane; spores smooth, about 8 μ in diameter. Type locality, Idaho.

ILLUSTRATIONS:—Card. & Thér. Bot. Gaz. **30:** *pl. 4, figs. 1a–1j;* Williams, Bull. N. Y. Bot. Gard. **2:** *pl. 36; Pl. 87.*

The type specimen of this species came from Cedar Creek, Latah County, Idaho. It has since been collected in Washington, Montana, and Utah. In the Wasatch Mountains of Utah, it seems to be more common than *B. convoluta.*

This species has much the appearance of *B. convoluta* and upon casual inspection might be mistaken for it. As a rule, however, the leaves are narrower, the costa shorter, and the perichaetium very different. *B. eustegia* rather closely resembles the European *B. flavipes*, but the whole plant, in all its parts is much smaller. Furthermore, the perichaetium of *B. eustegia* is of fewer leaves, and much smaller in relation to the stem leaves, which may sometimes surpass it.

3. BARBULA SPIRALIS Schimp. in C. Müll. Syn. Musc. **1:** 622. 1849.

Tortula spiralis Mitt. Jour. Linn. Soc. **12:** 151. 1869.

Plants of medium size, loosely caespitose, dull, yellowish-green; stems 0.5–3.0 cm. long, branching freely; leaves crowded, imbricated, scarcely crisped when dry, but arranged in a regular spiral manner, spreading and slightly recurved when moist, 1.5 mm. long, lanceolate-lingulate, with an obtuse apex, canaliculate; costa very stout, yellowish, pellucid, slightly papillose on the back above, excurrent into a very short, transparent mucro; margin or nearly the whole lamina widely revolute from just above the base to the apex, the extreme basal margin often plane; basal cells rectangular, 2–3 times as long as broad, hyaline or yellowish, transparent, smooth, upper cells much smaller, isodiametric, densely papillose, very obscure; perichaetial leaves somewhat broader at the base, otherwise hardly differentiated. Seta pale red or orange, very slender, about 15 mm. long; capsule ovate-cylindric; operculum conic-rostrate, half as long as the urn; peristome teeth rather long, papillose, deep red, much twisted, from a very narrow membrane. Type locality, Mexico.

ILLUSTRATION:—*Pl. 88.*

EXSICCATI:—Pringle, Plantae Mexicanae 10424, 10584; Bartram, Mosses So. Ariz. 56, 168; Holz., Musc. Acroc. Bor. Amer. 502.

Concerning the distribution of this species, Bartram (Bryologist **30:** 46. 1927) says: "This species is apparently quite common in the elevated districts of central Mexico and is certainly not uncommon in Arizona where it has been collected in a number of localities, usually on dry banks in the foothills of the border mountain ranges. Collections by Mr. Holzinger in New Mexico and by Mr. C. R. Orcutt in western Texas indicate that the species probably occurs throughout the arid southwest at elevations around 5000 feet."

From *B. platyneura*, this is easily separated by the larger size and less acute leaves, but especially by the much longer basal leaf cells. It seems to be related to the European *B. revoluta*, but differs in the much larger size and undifferentiated perichaetial leaves. I have not seen any U. S. material with sporophytes; the description given above was taken from Mexican specimens.

4. BARBULA PLATYNEURA C. Müll. & Kindb. in Macoun Cat. Can. Pl. **6:** 52. 1892.

Plants very small, dull yellowish- to brownish-green, densely caespitose; stems short, not exceeding 1 cm., simple or branching through innovations; leaves more crowded and larger at the apex of the stem, stiffly erect-spreading when moist, appressed and closely imbricated when dry, only slightly contorted and not spirally arranged, about 1 mm. long, lanceolate to ovate-lanceolate, gradually tapering from just above the base to an obtuse, obtusely acute or acute apex which is sharply mucronate or cuspidate with the very stout, yellowish, excurrent costa; margin, or the whole lamina, very widely and strongly revolute from near the base to the apex; basal cells quadrate to short-rectangular, smooth, pellucid, upper leaf cells thicker walled, smaller, densely papillose, very obscure. Sporophyte unknown. Type locality, British Columbia.

ILLUSTRATION:—*Pl. 88.*

EXSICCATI:—Macoun, Canad. Crypt. 12, Canad. Musci 195.

This species is still known only from the original specimen, collected at "Deer Park, Lower Arrow Lake, Columbia River, B. C." It seems to be the American counterpart of the European *B. Hornschuchiana*, from which it differs in its tendency toward a more obtuse leaf apex and the lack of spiral twisting of the leaves when dry. From *B. spiralis* it differs in smaller size, more acute leaves, and the short basal cells.

5. Barbula unguiculata Hedw. Sp. Musc. 118. 1801.

Barbula indigens (Ren. & Card.) Ren. & Card. Bull Soc. Roy. Bot. Belg. **36**[7]: 176. 1897 (type seen).
B. Saundersii Card. & Thér. Proc. Wash. Acad. Sci. **4**: 304. 1902 (type seen).

Plants in dense, glaucous to dark green tufts; stems short, rarely reaching 2 cm.; leaves appressed and variously contorted when dry, sometimes spirally twisted; erect-spreading and recurved to somewhat squarrose when moist, oblong to lingulate from an ovate base, apex generally blunt; costa strong, excurrent as a short yellow mucro, very papillose on the back; margins recurved in the basal half, plane above; basal cells thin-walled, elongated, rectangular, yellowish, becoming much smaller above, quadrate or rounded, cell walls thin to much thickened, densely papillose, very obscure; perichaetial leaves somewhat longer and narrower, sometimes sub-sheathing at the base, but never convolute. Seta variable in length, 0.5–2.5 cm. long, deep red, erect; capsule short- or long-cylindric; operculum rostrate, reaching half the length of the urn; annulus none; peristome teeth a deep, clear red, very long, twisted in at least two complete spiral turns, from a very short basal membrane; spores smooth, ripening in winter to early spring. Type locality, Europe.

Illustrations:—Hedw. Stirp. Crypt. **1**: *pl. 23;* Hedw. Sp. Musc. *pl. 26, figs. 1–4* (as *B. apiculata*), *figs. 5–8* (as *B. stricta*), *figs. 9–11* (as *B. lanceolata*); Bry. Eur. *pl. 142, 143;* DeNot. Musc. Ital. *pl. 23, figs. 1–8;* Lesq. & James, Manual, *pl. 1;* Husnot, Musc. Gall. *pl. 29, figs. 1–7;* Braithw. Brit. Moss Fl. **1**: *pl. 41D;* Roth, Eur. Laubm. *pl. 22, fig. 1, pl. 28, fig. 1;* Jennings, Mosses W. Pa. *pl. 13;* Dixon & Jam. Handb. Brit. Mosses (Ed. III) *pl. 28B;* Mönkem. Laubm. Eur., *fig. 60a;* Casares-Gil, Musgos, Fl. Ibér. *fig. 101, a–f;* M. H. M. *fig. 72.*

Exsiccati:—Drummond, Musc. Am. 62, 140; Sull. Musc. Allegh. 149; Sull. & Lesq. Musc. Bor. Am. (Ed. I) 96, (Ed. II) 128; Ren. & Card. Musc. Am. Sept. 214; Aust. Musci Appal. 124; Macoun, Canad. Musci 73, 206; Canad. Mosses 75; Holz. Musc. Acroc. Bor. Amer. 479; Reliquae Farlow, 555; Grout, Musci Perf. 92.

This extremely common and variable species usually grows on calcareous soil which is apt to be disturbed periodically, as in fields, old paths, on roadside banks, etc. It is known throughout eastern America from Newfoundland to North Carolina, becoming less common westward, where it reaches Montana, Utah, and New Mexico; also in Mexico.

The typical American plant differs from the European form in the less excurrent costa, which forms a shorter mucro, and the less hyaline basal cells, as well as in other less easily defined ways. Plants may be recognized in the field by the blunt, mucronate leaves, a character which does not require much magnification for demonstration. The innovations appearing in late spring and summer are a very bright, glaucous green, becoming darker through the season, so that fruiting specimens are often a very dull, dirty green color. Many variants, whose names reveal their nature, have been given formal recognition in the past, as *cuspidata, apiculata, microcarpa, obtusifolia, polycarpa, fastigiata,* etc. All these merge imperceptibly with the typical form, however, and are of no taxonomic value, even as forms.

6. Barbula Cruegeri Sond. in C. Müll. Syn. Musc. **1**: 618. 1849.

Tortula Cruegeri Mitt. Jour. Linn. Soc. **12**: 150. 1869.
Barbula cancellata C. Müll. Flora **56**: 483. 1873 (type seen).
B. Jooriana C. Müll. Bull. Torrey Club **5**[12]: 49. 1874 (type seen).
B. Closteri Aust. Bot. Gaz. **1**: 29. 1876 (type seen).
B. Ravenelii Aust. Bot. Gaz. **2**: 89. 1877 (type seen).
Tortula Closteri Aust. Bot. Gaz. **3**: 30. 1878.
Dialytrichia cancellata Broth. Kindb. Eur. & N. Am. Bryin. 291. 1897.
Desmatodon Bushii Card. & Thér. Bot. Gaz. **37**: 366. 1904 (ex descrip.).

Plants small, loosely caespitose, pale, glaucous or yellowish-green above, reddish-brown below; stems red, slender, short, rarely reaching 2 cm., simple or with a terminal innovation; leaves distant, curled and twisted, also inrolled from the apex, when dry, not imbricated, spreading to recurved when moist, about 1 mm. long, linear-lanceolate to oblong-lanceolate, obtuse, very short-mucronate from the only slightly excurrent costa, which is yellowish, and papillose on the back; margins revolute at base, plane above, rarely plane throughout; basal leaf cells rectangular and chlorophyllose or nearly hyaline, not papillose, upper cells very small and opaque, densely papillose; perichaetial leaves slightly longer, acuminate, lanceolate with a somewhat sheathing base, basal cells larger and more hyaline. Obovate, stalked, multicellular, reddish-brown propagula nearly always present along the stems, especially in the axils of the leaves. Seta red, straight, variable in length; capsule erect, small, oblong to short-cylindric, pale, thin-walled; lid long-

rostrate, sometimes as long as the capsule; annulus lacking; peristome teeth deep red, split nearly to the base, very long and very slender, closely twisted, often somewhat cancellate or trabeculate at the base and appendiculate above, fragile and very soon disappearing from deoperculate capsules. Spores very small, smooth. Type locality, Trinidad.

ILLUSTRATION:—*Pl. 88.*

EXSICCATI:—Ren. & Card. Musc. Am. Sept. Exsic. 23; Holz. Musc. Acro. Bor. Am. 477; 400 (as *B. Closteri*).

Growing on calcareous soil and rocks through the lowlands of tropical and subtropical America; in the United States apparently very common in the coastal plain regions of Texas, Louisiana and Florida; also known from Georgia (Ravenel), South Carolina, North Carolina, Tennessee (Sharp), New Jersey (Austin), and Missouri (Bush).

In spite of its frequency and wide distribution in the southern coastal plain, this interesting and variable species has not been at all well understood. It has a very superficial resemblance to *B. unguiculata*, which has resulted in a confusion of the two species, although they are really very distinct, and there is even practically no overlapping in their geographical ranges. The smaller size, paler color, and red stems are characters which serve to distinguish *B. Cruegeri* in a sterile condition. The one absolutely unmistakeable character is the presence in large or small quantity of the reddish propagula, which will be found on the great majority of plants. On some specimens careful search is necessary to demonstrate the propagula, but on others the propagula are so numerous that the whole plant is given a reddish tinge. The sporophyte is characterized by its smaller size; the capsule is shorter, paler, and thinner walled than in *B. unguiculata*. The peristome is fugaceous, and often strongly cancellate at the base (Ren. & Card. l. c. 23 demonstrates this very well). There is still some doubt as to the use of the name "Cruegeri." Our plant occurs in its typical propaguliferous form throughout the hot tropical lowlands, especially in the West Indies. However, what is apparently another species from the high mountains of Central and South America, without propagula, is also called *B. Cruegeri*. I have not been able to see the type specimen from Trinidad, but rely for my use of the name on the words of Renauld and Cardot (Bull. Herb. Boiss. **4**: 3. 1896), who say: "Ces échantillons de la Louisiane sont complètement identiques à ceux provenant de l'île de la Trinite, de l'Equateur et du Pérou."

7. BARBULA AGRARIA Hedw. Sp. Musc. 116. 1801.

Tortula agraria Sw. Fl. Ind. Occ. **3**: 1763. 1806.
Barbula Raui Aust. Bull. Torrey Club **6**: 43. 1875 (type seen).

Plants gregarious to caespitose, very small, almost stemless; leaves crowded, forming a rosette, not much curled or twisted when dry, spreading when moist, lanceolate to ovate-lanceolate, widest at or above the middle, narrowed to the base, which is oblong, of long, clear, smooth cells, upper cells isodiametric, quadrate to hexagonal, mamillose on the ventral surface, smooth on the dorsal surface, apex acute; costa stout, ending in a mucronate tip; margin plane, sometimes slightly recurved, entire; inner perichaetial leaves somewhat convolute. Seta red, straight; capsule cylindric, striate when dry; operculum very long-rostrate; annulus revoluble, deciduous; peristome red, papillose, twisted, teeth long and slender, from a well developed basal membrane; spores smooth, small, maturing in spring. Type locality, Jamaica and Hispaniola.

ILLUSTRATIONS:—Hedw. Stirp. Crypt. **3**: *pl. 6B, figs. 1–9;* Britton, Fl. Bermuda, *fig. on p. 440;* Broth. in Engler & Prantl (Ed. 2) **10**: *fig. 243; Pl. 88.*

EXSICCATI:—Drummond, Musc. Am. 64; Aust. Musc. Appal. Suppl. 495 (as *T. Rauei*); Holz. Musc. Acro. Bor. Am. 59 (as *B. Raui*); Grout, Musci Perf. 194 (as *T. Raui*).

On limestone, or occasionally calcareous soil, Florida (very common), Louisiana, and Texas. It is widespread throughout tropical America.

This species approaches *Barbula* in the structure of its costa, but on the basis of leaf-shape it is frequently placed in *Tortula*. It is sufficiently distinct from both genera, however, to justify, perhaps, the eventual erection of a new genus.

8. BARBULA EHRENBERGII (Lor.) Fleisch. Musci Archipel. Ind. Ser. IV, No. 161. 1901.

Trichostomum Ehrenbergii Lor. Abhandl. K. Akad. Wiss. Berlin **1867**: 25. 1868.

Plants of medium size, dull yellowish- to brownish-green, in dense tufts, often incrusted with a calcareous deposit; stems 1–5 cm. long, usually simple or irregularly branched; leaves flaccid, somewhat crisped when dry, erect spreading when moist, 2–3 mm. long, oblong-lanceolate to subligulate; the costa ending in or just below the obtuse to subacute apex; margin plane to very slightly recurved; basal cells thin-walled, elongated, enlarged, pellucid, upper cells isodiametric, polygonal, smaller, slightly papillose or smooth,

thin walled. Club-shaped propagula are present on some plants. Always sterile in our region. Type locality, Mesopotamia.

ILLUSTRATIONS:—Lorenz, Abhandl. K. Wiss. Berlin 1867: *pl. 4, figs. 1–6, pl. 5, figs. 7–19;* Limpr. Laubm. *fig. 172;* Roth, Eur. Laubm. *pl. 20, fig. 9, pl. 21, fig. 8;* Mönkem. Laubm. Eur. *fig. 53b; Pl. 89.*

To Mr. Bartram must go the credit for recognizing this species in our range. In his herbarium are specimens from the Arbuckle Mts. and Platt National Park, Oklahoma; Comal Springs, New Braunfels, and "Head of Rio Frio," Texas, and Douglas County, Missouri. The species will undoubtedly turn up elsewhere in the south and west.

Although fruit has been found in several collections of a closely related species or variant of this species from British Honduras, the material is enough different to prevent the sporophytic characters being safely incorporated here. The plants grow in dense tufts on limestone or calcareous soil, often in running water, and would perhaps be more easily mistaken for a *Didymodon* or *Trichostomum* than any other species of *Barbula.*

9. BARBULA FALLAX Hedw. Sp. Musc. 120. 1801.

Barbula acuminata Hedw. Sp. Musc. 117. 1801.
B. sparsidens C. Müll. & Kindb. in Macoun Cat. Can. Pl. **6:** 54. 1892 (type seen).
B. decursivula Kindb. in Macoun Cat. Can. Pl. **6:** 264. 1892 (type seen).

Plants densely and widely caespitose, dull brownish- or reddish-green; stems slender, often bearing several innovations, 1–3 cm. high, leaves rather distant, wide-spreading to recurved when moist, appressed, closely imbricated, somewhat twisted when dry, lanceolate from an ovate base, gradually tapering to a slender, acute or subacute apex, 1.5–2.5 mm. long, keeled, somewhat plicate at base on each side of costa; margin entire, strongly revolute to above the middle; costa strong, tapering upwards, disappearing in the apex, the ventral surface composed of elongated cells (in surface view); leaf cells small and thick-walled, often appearing stellate, strongly papillose, obscure, basal cells gradually somewhat larger and slightly longer, the lowest row elongated-rectangular, all basal cells smooth; perichaetial leaves with subsheathing base and elongated-rectangular, hyaline basal cells. Seta red, 1–1.5 cm. long; capsule elongated-ovoid to subcylindric, nearly symmetric; operculum long and sharply rostrate; peristome deep, clear red, not becoming paler with age, long, delicate, and much twisted, from a short basal membrane; spores smooth, ripening from late autumn to early spring. Type locality, Europe.

ILLUSTRATIONS:—Hedw. Stirp. Crypt. **1:** *pl. 24;* Hedw. Sp. Musc. *pl. 25, figs. 5–7;* Bry. Eur. *pl. 147;* DeNot. Musc. Ital. *pl. 29, figs. 1–20;* Braithw. Brit. Moss Fl. **1:** *pl. 39D;* Husnot, Musc. Gall. *pl. 29;* Roth, Eur. Laubm. *pl. 23, fig. 8;* Broth. in Engler & Prantl (Ed. II) **10:** *fig. 227, a–d;* Dixon & Jam. Handb. Brit. Mosses (Ed. III) *pl. 26J;* Mönkem. Laubm. Eur. *fig. 62c;* Casares-Gil, Musgos, Fl. Ibér. *fig. 106, a–h;* M. H. M. *pl. 29.*

EXSICCATI:—Drummond, Musc. Am. 139; Sulliv. & Lesq., Musc. Bor. Am. (Ed. II) 129; Aust. Musc. Appal. 125; Ren. & Card. Musc. Am. Sept. 215; Macoun, Mosses of Canada, 72; Macoun, Canad. Crypt. 26 (as *B. decursivula*); Holz. Musc. Acro. Bor. Am. 18 in part (as *B. unguiculata*), 254; Grout, Musci. Perf. 144.

Common and widespread through eastern and central North America from Nova Scotia to Virginia, west to Iowa and Minnesota. Farther west, the species seems to be much rarer, although a few fairly typical specimens have come from Montana and Idaho. The two British Columbia specimens which were described as two new species, *B. decursivula* and *B. sparsidens*, by Kindberg are very much reduced and hardly recognizable as belonging to this species. Although *B. fallax* has been reported many times from the Pacific Coast, especially from California, the specimens all belong to other species, usually *B. vinealis.* Although *B. fallax* is rather variable, it (and its allies) may be easily separated from the species with which it is commonly confused by an easily observed and clear-cut characteristic, namely, the elongated cells (in surface view) of the ventral surface of the costa. Furthermore, the peristome is of a clear, bright red, and does not become paler with age.

10. BARBULA REFLEXA (Brid.) Brid. Method. Musc. 93. 1822.

Tortula reflexa Brid. Musc. Recent. Suppl. **1:** 255. 1806.
Barbula recurvifolia Schimp. Coroll. Bry. Eur. 33. 1855.

Plants loosely caespitose, deep reddish-brown, stems slender, branching, 1–4 cm. long, leaves contorted and crisped when dry, strongly recurved and somewhat squarrose when moist, often appearing three-ranked, lanceolate from a widely ovate base, sharply keeled, widely revolute in the lower half, plane above, with two conspicuous plicae at base; costa reddish-brown, ending in or below the acute apex, never excurrent,

strongly papillose, in cross section showing usually two guide cells which are scarcely larger than the others; upper leaf cells much thickened, small, roundish, very strongly papillose, obscure, basal cells somewhat larger, quadrate to short-rectangular, smooth. Sporophyte as in *B. fallax;* exceedingly rare, spores ripening in winter and early spring. Type locality, Europe.

ILLUSTRATIONS:—Braithw. Brit. Moss Fl. **1**: *pl. 39E;* Husnot, Musc. Gall. *pl. 29;* Roth, Eur. Laubm. *pl. 23, fig. 7;* Dixon & Jam. Handb. Brit. Mosses (Ed. III) *pl. 27A;* Mönkem. Laubm. Eur. *fig. 60m;* Casares-Gil, Musgos, Fl. Ibér. *fig. 107, a–c; Pl. 86.*

EXSICCATI:—Aust. Musc. Appal. Suppl. I, 496; Holz. Musc. Acro. Bor. Am. 478; Macoun, Canad. Musci 201a, Canad. Mosses 58a.

Growing usually on calcareous soil or rocks, with about the same geographic distribution as *B. fallax,* but apparently much less common. I have seen specimens which certainly belong here from as far south as Virginia, as far west as New Mexico and Colorado, and as far north as the Yukon.

Although this moss appears to approach and intergrade with *B. fallax,* and is obviously very closely related to it, it is not particularly variable. Different authors have considered it as a separate species, or variously as a form, variety, or subspecies of *B. fallax.* It is probably best considered a "small" species or a subspecies of *B. fallax,* from which it differs fairly consistently in the redder color, more papillose leaves, which are more strongly recurved or even squarrose.

11. **Barbula michiganensis** sp. nov.

Plantae flavo-virides, dense caespitosae: folia superiora siccata contorta haud crispata, sed madida erecto-patentia, basi late ovata caulem amplectentia, apice abrupte contracta breviter acuta paulum reflexa; costa crassa valde aut vix percurrenti; margine recurvata ex basi ad laminae mediam; cellulis conspicue seriatis valde incrassatis, isodiametricis papillosis sed visibilibus, prope laminae basin paulum majoribus, levibus, epapillosis, superioribus omnino similibus. Propagula rufa rotunda multicellula in foliorum axillis numerosa. Sporogonium ignotum. *B. fallaci* affinis differt foliis erecto-patentibus et propagulis numerosis. Specimina typica ex loco "Pictured Rocks" dicto, Alger County, Michigan, in rupibus arenosis calcareis a G. E. Nichols et W. C. Steere lecta, Aug. 20, 1935, in Herb. Univ. Mich. conservata; dupla in Herb. Univ. Yale et Herb. A. J. Grout.

Plants small, yellowish-green, densely tufted; stems erect, 5–10 mm. long, red; leaves not crowded toward the stem apex, the apical leaves twisted when dry, but none of them at all crisped, each leaf incurved toward the stem, giving a catenulate appearance to the leafy stem, erect and imbricated to erect-spreading when moist, 1 mm. long, not plicate, the base broadly ovate, short-decurrent, clasping the stem, rather suddenly contracted above to the short, acute apex, which is usually somewhat reflexed; costa strong, gradually tapering upwards, ending in or just below the apex, scabrous on the back, the ventral surface composed of greatly elongated cells, in cross section showing about four guide cells of small diameter, a dorsal band of small stereids, and a ventral area of thick-walled stereids, whose diameter approaches that of the guide cells; margin narrowly revolute from near the base to above the middle, or nearly to the apex in some leaves, often somewhat irregularly sinuate; leaf cells conspicuously arranged in rows parallel to the costa, extremely thick-walled, the lumen round or oval, if oval, then wider than long, not very papillose, not at all obscure, basal cells slightly larger, smooth, otherwise hardly different, only the lowermost row noticeably longer. Numerous smooth, clear reddish-brown, spherical or oval, multicellular (2–6 cells) propagula, 25–30 μ in diameter, present in the leaf axils. Sporophyte unknown.

Type specimen from ledges of soft, calcareous Cambrian sandstone, Pictured Rocks, Alger County, Michigan; collected by G. E. Nichols and W. C. Steere, Aug. 20, 1935.

ILLUSTRATION:—*Pl. 89.*

Although this species is known only from the type locality, from which several collections of it have been made at different times, it seems distinct enough to justify recognition. The very thick-walled, seriate cells of the lamina, the elongated cells of the ventral surface of the costa, as well as the whole general appearance of the plant, especially the catenulate leaf-arrangement when dry, all point to a definite relationship with *B. fallax.* However, the clasping, erect leaf base, with only the apex reflexed and erect-spreading is very different from the widely reflexed-spreading leaf arrangement in *B. fallax* and, still more, in *B. reflexa.* The cells are thicker-walled, less papillose, and much more definitely arranged in parallel rows than usual in *B. fallax,* also. The really unique feature, however, is the presence of great numbers of reddish, spherical propagula in the axil of each leaf, as this type of propagulum is not known otherwise in our American species, nor have propagula been reported for either *B. fallax* or *B. reflexa.*

12. Barbula Johansenii Williams, Rept. Canad. Arct. Exped. 1913–18, **4(E)**: 4. 1921.

Plants very small, caespitose, green; stems simple, short, reaching 3–4 mm., with rhizoids at the base, central strand rather indistinct; stem-leaves erect, rather closely appressed-imbricate when dry, ovate-lanceolate, the blade up to 1.5 mm. long and 0.4 mm. wide, with an excurrent costa up to 130 μ long above the blade, often enlarging and somewhat flattened toward the apex and mostly broken off in the older leaves; in cross section showing 2–4 guide cells without stereid cells in the upper part but in lower costa with rather small, thick-walled cells above and below the guide cells, extending to the surface; leaf margin entire, more or less recurved along the middle; cells of leaf smooth, in the upper half of leaf blade mostly transversely oval with thickened walls, the median cells 8–10 μ x 5–8 μ, gradually changing below the middle of the leaf to the more or less oblong or rectangular and paler cells of the basal part. Sporophyte unknown. Type locality, North West Territory, Canada.

Illustrations:—Williams, l. c. 1913–18, **4(E)**: *figs. 1–12; Pl. 81.*

Known only from the type locality, Murray Point, Victoria Island, Arctic Northwest Territory, lat. 6° 40′ N., on dolomite cliffs (Frits Johansen).

"This species comes nearest to *B. acuta* (Brid.) Brid., but the elongate basal cells extend farther up the leaf and the stereids of the lower part of the costa are not so well defined." Of course, the swollen, caducous apex of the costa is unique in the genus, and may perhaps serve in some way for vegetative reproduction.

13. Barbula icmadophila Schimp. Bryol. Eur. fasc. 43, Suppl. II. 1850.

Tortula icmadophila Lindb. De Tort. 249. 1864.

Plants in dense, often small, brownish-green tufts, stems 1–3 cm. high, leaves hardly crispate when dry, erect-spreading when moist, 1.0–1.5 mm. long, lanceolate, rather suddenly contracted from an ovate base to a subulate apex consisting mainly of the long-excurrent costa; leaf cells isodiametric, thick-walled, distinct, nearly smooth, somewhat larger and shortly rectangular at the base; perichaetial leaves longer, with a still more strongly excurrent costa which forms a flexuous subula. Fruiting plants not known from North America. The sporophyte is reported to be very similar to that of *B. acuta*, although the capsule is somewhat longer. Type locality, Germany.

Illustrations:—Bry. Eur. *pl. 146;* Husnot, Musc. Gall. *pl. 30, figs. 1–6;* Roth, Eur. Laubm. *pl. 23, fig. 9;* Dixon & Jam. Handb. Brit. Mosses (Ed. III) *pl. 271;* Mönkem. Laubm. Eur. *fig. 60f; Pl. 86.*

Exsiccati:—Drummond, Musc. Am. 139, in part.

Only two specimens, both sterile, of this species give reasonable certainty for its existence in North America. They are Williams' 143a from Columbia Falls, Montana, and Drummond's 139 from "Banks of rivers, near the Rocky Mountains," Canada. Although both collections differ from European material in the somewhat papillose cells and shorter stems, they agree pretty well otherwise. In fact, Mitten has said of Drummond's *B. icmadophila*, which occurs only as a very slight admixture with *B. fallax*, "fine specimens."

14. Barbula acuta (Brid.) Brid. Method. Musc. 96. 1822.

Tortula acuta Brid. Musc. Recent. Suppl. **1**: 265. 1806.
Barbula gracilis Schwaegr. Sp. Musc. Suppl. **1**[1]: 125. 1811.

Plants in dense tufts, dark green to brown; stems slender, short, 0.5–2.0 cm. long, straight, rather rigid; leaves appressed when dry, but only slightly twisted or contorted; stiffly erect-spreading when moist, small, gradually tapered to an acute point from an ovate base, the strong costa distinctly excurrent in most leaves; margin widely recurved below, plane above; leaf cells all thick-walled, smooth or very nearly so, distinct, isodiametric above, somewhat larger and quadrate to short-rectangular below; perichaetial leaves larger, wider, more transparent at the base, the costa longer excurrent. Seta 5–10 mm. long, red, straight; capsule small, oval to short-cylindric; operculum long, slender; peristome short, twisted in about one complete turn; spores smooth, ripening in winter. Type locality, Europe.

Illustrations:—Schwaegr. l. c. *pl. 34, figs. 1–9;* Bry. Eur. *pl. 145;* DeNot. Musc. Ital. *pl. 28, figs. 1–21;* Braithw. Brit. Moss Fl. **1**: *pl. 40C;* Husnot, Musc. Gall. *pl. 29, figs. 1–8;* Roth, Eur. Laubm. *pl. 23, fig. 6;* Dixon & Jam. Handb. Brit. Mosses (Ed. III) *pl. 27I;* Mönkem. Laubm. Eur. *fig. 60e;* Casares-Gil, Musgos, Fl. Ibér. *fig. 105, a–e; Pl. 86.*

Exsiccati:—Baker, Pacific Slope Bryophytes 33 (as *B. Bakeri*).

Apparently a rare species in our range, growing usually on calcareous rocks, British Columbia, Idaho, Montana, New Mexico, Arizona, and California; also known from very widely scattered localities in several of the eastern states. The American specimens which I have placed here are all slightly papillose and differ in other ways from typical European material. This fact, combined with the great variability of the material, and the very curious geographical distribution of the species in our range, arouses the suspicion that we may be dealing here with a different species, or perhaps a complex of two species.

15. BARBULA BESCHERELLEI Sauerb. in Jaeg. Adumb. **2**: 673. 1878.

B. rigidula Besch. Prodr. Bryol. Mex. 36. 1871 (not *B. rigidula* Mitt.).

Plants brownish- to reddish-green, in wide loose tufts, stems 1–4 cm. long; leaves appressed-imbricate, very little crisped or contorted when dry, widely spreading to recurved when moist, 1.5–2 mm. long, ovate-lanceolate, gradually tapering from an ovate base to a subulate apex consisting in large part of the long-excurrent costa, somewhat roughened on the back above; margins revolute from the base nearly to the apex; cells thick-walled, rounded, smooth to very slightly papillose, very uniform, not much larger toward the base; perichaetial leaves longer and wider, sub-sheathing, very long-excurrent. Seta red, 1–2 cm. long, straight; capsule dark red, long and narrowly cylindric, narrowed very gradually toward the mouth; operculum long-rostrate, reaching half the length of the urn; peristome long, twisted in about two complete turns, its short basal membrane inserted below the mouth. Type locality, Mexico.

ILLUSTRATION:—*Pl. 88.*

EXSICCATI:—Pringle, Plantae Mexicanae 10432, 10447, 10543, 10626; Bartram, Mosses So. Ariz. 130; Holz. Musc. Acro. Bor. Am. 552.

A Mexican species which is known in our range only from Arizona and New Mexico. Of its distribution in Arizona, Mr. Bartram says: "It is abundant in the oak forests of the Patagonia and Santa Rita Mts., and frequently grows in dense cushions around the bases of the trees. The species is ordinarily sterile in Arizona, but a fertile colony of several hundred plants was found on shaded ledges along the Baldy Trail, Santa Rita Mts., at an elevation of about 6500 feet."

This species differs from *B. acuta* in its longer stems, more revolute leaf margins, much longer capsule, and the longer, more twisted peristome teeth.

16. BARBULA RUBIGINOSA Mitt. Journ. Linn. Soc. **8**: 27. 1865.

Barbula subicmadophila C. Müll. & Kindb. in Macoun Cat. Can. Pl. **6**: 53. 1892 (type seen).
B. melanocarpa C. Müll. & Kindb. in Macoun Cat. Can. Pl. **6**: 54. 1892 (type seen).
Barbula Dieckii Broth. in Röll, Hedwigia **32**: 262. 1893 (type seen).
Didymodon Dieckii Kindb. Eur. & N.-Amer. Bryin. 278. 1897.

Plants large, densely to loosely caespitose, reddish-brown above, nearly black below; stems simple or with few innovations, 1–2 cm. long; leaves appresssed-imbricate, slightly contorted when dry, spreading when moist, subulate-lanceolate from an ovate base, decurrent at the angles, 2 mm. long; margin slightly to strongly recurved; costa strong, ending in the somewhat thickened leaf apex; basal cells thick-walled, isodiametric to transversely elongated, very uniform, gradually merging with the upper cells which are smaller, papillose, and rather obscure; perichaetial leaves erect, the swollen base somewhat sheathing, the costa excurrent beyond the subulate apex. Seta red, 1–2 cm. long; capsule erect, oval-cylindric; operculum conic-rostrate, half the length of the urn or shorter, very dark; peristome completely lacking, spores very small, smooth. Type locality, "N. W. America."

ILLUSTRATIONS:—Mitt. Jour. Linn. Soc. **8**: *pl. 5; Pl. 81.*

EXSICCATI:—Macoun, Canad. Mosses 54a, Canad. Musci 75, in part, 203 (as *B. melanocarpa*); Holz. Musc. Acro. Bor. Am. & Eur. 554.

Collections have been seen from Oregon, Washington, Idaho, Montana, and British Columbia. The species seems to be especially common along the Columbia River.

This species seems to be confused frequently with *B. cylindrica*, from which it differs most conspicuously in its complete lack of any peristome. Sterile specimens are easily recognized by the more decurrent leaves, which are less contorted when dry and less flexuous when moist, as well as by the extremely uniform, short basal leaf cells, which may be actually transversely elongated. The relationships of this species in the genus *Barbula* are very obscure. I find myself somewhat in sympathy with Kindberg, who placed it in *Didymodon.*

17. Barbula brachyphylla Sull. Rept. Pacif. R. R. Surv. (35th Parallel) **4**: 186. 1856.

Barbula purpurea C. Müll. Flora **58**: 78. 1875 (type seen).

Plants in dense, reddish-brown tufts; stems short, less than 0.5 cm. long, branching from innovations; leaves 1–1.5 mm. long appressed-imbricate when dry, not at all crisped or contorted, erect-spreading when moist, ovate, rather suddenly narrowed to the obtuse or obtusely acute apex; costa very stout, not tapering to the apex, but of the same width throughout, percurrent, or slightly excurrent as a broad mucro; complete margin strongly recurved; cells small, very thick-walled, isodiametric, papillose, basal cells somewhat larger, but only slightly elongated; perichaetial leaves longer, wider, sheathing at the base. Seta 10–15 mm. long, straight; capsule cylindric, erect; peristome teeth long, papillose, red, becoming pale with age, not much twisted, from a very short basal membrane; operculum long-rostrate, reaching half the length of the urn; spores very small, smooth. Type locality, Benicia, California.

Illustrations:—Sull. l. c. *pl. 2, figs. 1–18; Pl. 87.*

Exsiccati:—Sull. & Lesq. Musc. Bor. Am. (Ed. I) 100c, (Ed. II) 135; Baker, Pacific Slope Bryoph. 352, in part.

This species is known from California only, but may be expected elsewhere in the southwest. It is apparently the most reduced form of the extremely variable *B. vinealis-B. cylindrica* complex, to which the dusty red peristome, becoming paler with age, obviously allies it. It differs conspicuously, however, in the small size, the often blunt leaves, recurved from base to apex, and the only slightly twisted peristome teeth.

18. Barbula vinealis Brid. Bryol. Univ. **1**: 830. 1826.

Tortula vinealis Spruce, Hook. Jour. Bot. **4**: 194. 1845.
Barbula semitorta Sulliv. Rept. Pacific R. R. Surv. (35th Parallel) **4**: 186. 1856 (type seen).
B. virescens Lesq. Trans. Amer. Phil. Soc. **13**: 4. 1865 (type seen).
B. cylindrica (Tayl.) Schimp. var. *vinealis* Lindb. Musc. Scand. 22. 1879.
B. brachyphylla Sulliv. var. *angustifolia* Kindb. in Macoun Cat. Can. Pl. **6**: 55. 1892 (type seen).
B. lateritia Kindb. Eur. & N.-Amer. Bryin. 264. 1897 (type seen).
B. Treleasii Card. & Thér. Proc. Wash. Acad. Sci. **4**: 305. 1902 (type seen).

Plants brownish- to reddish-green, densely caespitose; stems usually short, 1–3 cm. long; leaves spreading to somewhat recurved when moist, closely appressed to the stem, twisted, sometimes spirally so, especially at the tip of the stem, when dry, narrowly lanceolate from an ovate base; costa stout, brown, ending in the acute apex, which sometimes is terminated by a single pellucid cell, the ventral cells of the costa (in surface view) quadrate to short rectangular; margin recurved to above the middle, sometimes nearly to the apex; upper leaf cells small, thick-walled, papillose; basal cells larger, smooth and rectangular; perichaetial leaves subulate-lanceolate from a slightly sheathing base, the costa excurrent. Seta dark red, straight; the capsule subcylindric, dark brown; operculum sharply rostrate; peristome dusty red, becoming paler with age, fragile and soon disappearing, twisted into at least one complete turn. Spores ripening in spring and early summer. Type locality, Europe.

Illustrations:—Bry. Eur. *pl. 148;* DeNot. Musc. Ital. *pl. 30, figs. 1–19;* Braithw. Brit. Moss Fl. **1**: *pl. 40D;* Husnot, Musc. Gall. *pl. 29;* Roth, Eur. Laubm. *pl. 23, fig. 11;* Dixon & Jam. Handb. Brit. Mosses (Ed. III) *pl. 27G;* Mönkem. Laubm. Eur. *fig. 60k;* Casares-Gil, Musgos, Fl. Ibér. *fig. 109, a–g; Pl. 86.*

Exsiccati:—Sull. & Lesq. Musc. Bor. Am. (Ed. I) 96b, (Ed. II) 130, 131; 132 (as *B. flexifolia*); 133 in part (as *B. artocarpa*); 134 (as *B. virescens*); Heller, Calif. Plants 7256, 7274; 6514 (as *B. semitorta*); Baker, Pacific Slope Bryoph. 35 (as *B. Bakeri*); Allen, Mosses of Cascade Mts. 23, in part; Holz. Musc. Acro. Bor. Am. 87, 385, 578; 157 (as *B. Bakeri*); Grout, Musci Perf. 132; Macoun, Canad. Mosses 456.

Growing on rocks and soil, which are usually of a calcareous nature. Widely distributed in the Pacific Coast area from Mexico to Alaska, extending eastward to Idaho and Montana.

This is without doubt our most variable species of Barbula, and is represented, especially in California, by a perplexing series of races and habitat forms, many of which have been proposed as species. Sullivant's *B. brachyphylla*, which apparently represents the most reduced state of *B. vinealis*, usually with a blunt leaf apex and with the whole leaf margin recurved, is distinct enough for recognition as a species or subspecies, in its typical form. Puzzling intermediate forms do occur, however. On the other hand, the more robust forms of *B. vinealis* intergrade with *B. cylindrica*. Yet the total range of these three "species" is too great to enable us to lump them under one name. Perhaps further study will uncover better morphological and qualitative distinctions between them. *B. vinealis* has long been confused with *B. fallax*, with the result that in every herbarium there are too many specimens labelled "B. fallax," especially from the Pacific Coast. Although there are many forms of *B. vinealis* which almost exactly duplicate the macroscopic facies

of *B. fallax*, the geographical ranges hardly overlap, and under the microscope the two species are very distinct. The leaf cells of *B. vinealis* are ordinarily much less papillose, and the peristome teeth are rarely a deep, clear red, but have a dusty or glaucous quality, and become much paler or even completely white with age. An inspection of the ventral (upper) surface of the costa under the microscope will separate the two species without any question, as in *B. vinealis* the cells are short, appearing as a continuation of the leaf blade across the costa, whereas in *B. fallax* the cells are much elongated to linear, very different from those of the lamina.

19. BARBULA CYLINDRICA (Tayl.) Schimp. in Ruthe, Hedwigia **12**: 46. 1873.

Zygotrichia cylindrica Tayl. in Mackay, Fl. Hib. **2**: 26. 1836.
Tortula cylindrica Lindb. Bot. Not. **1865**: 76. 1865.
Barbula flexifolia Hampe, Linn. **30**: 456. 1860 (type seen).
B. subfallax C. Müll. Bot. Zeit. **20**: 338. 1862 (type seen).
B. insulana Husnot, Mouss. N. Ouest 81. 1873.
B. Beecheyi Lesq. in Watson, Bot. Calif. **2**: 372. 1880.
B. vinealis Brid. var. *cylindrica* Boulay, Mouss. France 430. 1884.
B. subcylindrica Broth. Bot. Centralbl. **44**: 387. 1890 (type seen).
B. robustifolia C. Müll. & Kindb. in Macoun Cat. Can. Pl. **6**: 56. 1892 (type seen).
B. circinnatula C. Müll. & Kindb. in Macoun Cat. Can. Pl. **6**: 56. 1892 (type seen).
B. tortellifolia C. Müll. & Kindb. in Macoun Cat. Can. Pl. **6**: 56. 1892 (type seen).
B. horridifolia C. Müll. & Kindb. in Macoun Cat. Can. Pl. **6**: 57. 1892 (type seen).
B. pseudorigidula Kindb. in Macoun Cat. Can. Pl. **6**: 264. 1892 (type seen).

Plants loosely caespitose, dark green with a dull brownish to reddish tinge; stems slender, flexuous, 1–6 cm. long; lower leaves short and distant, lanceolate, the upper leaves crowded and very much longer, much contorted when dry, widely spreading and flexuous when moist, long subulate-lanceolate from an oblong or ovate base, 2.5–5 mm. long; margin narrowly recurved in lower part, usually plane above the middle; costa stout, disappearing in the acute or subacute apex, the ventral cells quadrate to short-rectangular in surface view, except at the very base; cells of the lamina small, irregularly quadrate, very papillose, obscure, gradually becoming smooth, pellucid and more regularly quadrate below, the lowermost shortly rectangular; perichaetial leaves not particularly differentiated, sometimes with excurrent costa. Seta long, 1.5–3 cm., flexuous, dark red to brown; capsule oblong-cylindric; lid long and sharply rostrate; peristome a dusty red, finally becoming pale with age, long, delicate, spirally twisted in 1–3 complete turns; spores in spring. Type locality, Ireland.

ILLUSTRATIONS:—Braithw. Brit. Moss Fl. **1**: *pl. 40D;* Husnot, Musc. Gall. *pl. 29, figs. 1–7;* Roth, Eur. Laubm. *pl. 23, fig. 12;* Dixon & Jam. Handb. Brit. Mosses (Ed. III) *pl. 27F;* Casares-Gil, Musgos, Fl. Ibér. *fig. 108, a–f; Pl. 86.*

EXSICCATI:—Baker, Pacific Slope Bryoph. 488, in part (as *B. subfallax*); Ren. & Card. Musc. Am. Sept. 24 (as *B. flexifolia*), 282, 283; Allen. Mosses of Cascade Mts. 22, 23 (as *B. vinealis*); Holz. Musc. Acro. Bor. Am. 208 (as *B. convoluta*), 503 (as *B. subfallax*), 87 (as *B. vinealis*); Macoun, Canad. Musci 81, 210, 633; 75 (as *B. rubiginosa*), 200 (as *B. fallax*), 211 (as *B. robustifolia*), 542 and 214 (as *B. horridifolia*), 212 (as *B. tortellifolia*), 613 (as *B. circinnatula*), 623 (as *B. vinealis*), 399 (as *B. flexifolia*); Macoun, Canad. Mosses 455; 72 (as *B. circinnatula*), 74 (as *B. robustifolia*), 73 (as *B. tortellifolia*); Bartram, Mosses So. Ariz. 48; Grout, Musci Perf. 76 (as *B. vinealis*).

On rocks and soil, usually calcareous, throughout the Pacific Coast region from Mexico to Alaska, east to Montana and Idaho. It seems to be best developed and most common in Oregon, Washington, and British Columbia. I have one collection from Keweenaw County, Michigan, which certainly belongs here, in spite of the remarkable disjunction of the geographical range which is involved.

This species, when well developed, is apt to be confused with none of our other species except, perhaps, *B. rubiginosa*, from which it is easily distinguished by the characters already noted under that species. There is a wide range of variation in *B. cylindrica*, as the extensive synonymy shows. Some of the specimens from British Columbia are much larger than any European specimens I have seen, whereas other specimens from farther south are much smaller and approach *B. vinealis* very closely. Apparently the fundamental differences between *B. cylindrica* and *B. vinealis* are as much quantitative as strictly qualitative, as no single morphological characteristic is limited exclusively to either one species or the other. In general, the longer and much more flexuous leaves, which are less strongly revolute, and the more papillose cells, which are also smaller, will serve as the identifying marks for *B. cylindrica.*

Excluded species.

A large number of species hitherto placed in *Barbula* by various authors are actually members of other genera, especially *Tortula*, which have not yet been revised for this work. As these species will eventually be suitably disposed of in the consideration of *Tortula* and other genera, and will also appear in the index for this volume, the use of space here for a catalogue of them would hardly be justified.

Two "species" are perhaps worthy of special mention, however. *Barbula andreoides* Kindb. (Rev. Bryol. **32**: 36, 1905) and *B. subandreaoides* Kindb. (ibid.) are both forms of *Andreaea Rothii* Web. & Mohr. I wish to thank Dr. A. J. Sharp for confirming my suspicion of this remarkable lapse on the part of Kindberg.

15. RHEXOPHYLLUM Herz. Bibl. Bot. Heft. **87**: 38. 1916.

Plants loosely tufted; leaves squarrose-spreading when moist, when dry incurved subcrispate, carinate, lanceolate; margins more or less revolute, serrate above; costa with median guides and dorsal and ventral stereid bands, nearly percurrent to long excurrent; upper leaf cells bistratose except at the margins, obscure, papillose, smooth, rectangular and clear in the basal portion, yellowish; perichaetial leaves longer, sheathing at base. Probably dioicous; seta elongate; capsule elliptic to cylindric; annulus present; operculum conic to rostrate; peristome lacking. Type species *R. laciniatum* Herz.

Rhexophyllum subnigrum (Mitt.) Thér. & Hilp. Stud. Zur. Syst. der Trichost., Bot. Centralb. **50**: Abt. II. Heft. 3, 684 and 702. 1933.

Tortula subnigra Mitt. Jour. Linn. Soc. **12**: 164. 1869.
Neocardotia subnigra Thér. & Bartr. Smithsonian Misc. **85**[4]: 12. 1938.
Morinia trichostomoides Bartr. Mosses S. Arizona 105, and Holz. Musc. Acro. Bor. Am. 569, Bartram's collection no. 813. (Not of Cardot Rev. Bryol. **37**: 124. 1910.)

Plants dark brownish-green; stems 2–4 cm. long; leaves lanceolate from a broader subsheathing base, acute, 3–4 mm. long; costa at base 60–80 μ wide, more or less roughened on the back above, subpercurrent to excurrent; upper leaf cells 6–7 μ in diameter, irregular, rounded, rather thick-walled, with small blunt papillae. Seta about 1 cm. long; capsule erect and symmetric, cylindric; operculum short-conic; spores smooth, 12–18 μ. Type locality, Mexico.

Illustration:—*Pl. 91* (in pt. 4).
On rocks, White House Canyon, Santa Rita Mts., Santa Cruz Co., Arizona, alt. 6500 ft. (Bartram no. 813); also several other collections in Arizona and New Mexico. The determination as *Morinia* was made by Dr. V. F. Brotherus. Thériot and Bartram discovered its identity with *Tortula subnigra*. They remark, l. c. p. 13: "The plant from Arizona shows some differences as compared with the Mexican plant, slight differences it is true, but worthy of mention; it is a little more slender, the leaves are more shortly acuminate, and their cells less regularly bistratose."

16. DIDYMODON Hedw. Descr. et Adumb. Musc. Frond. **3**: 8. 1792; Sp. Musc. 104. 1801.

William Campbell Steere*

Plants ranging in size from slender to very large, loosely to densely tufted, green to brownish-red; stems with central strand, radiculose below, branching; leaves crowded, erect-spreading, more or less carinate, usually lanceolate from a broader base; margin almost always revolute; costa strong, rarely excurrent, in the upper part of the leaf usually round in section, showing in section a single median row of from 4 to 6 guide cells with usually well developed ventral and dorsal stereid regions; leaf cells small, roundish to quadrate, smooth or usually papillose, sometimes elongated and hyaline at the base; perichaetial leaves scarcely differentiated. Vegetative propagation from propagula of various types. Seta elongated, erect; capsule erect, oblong to cylindric, sometimes slightly curved, short-necked, not striate; annulus not differentiated, never revoluble (except in *D. recurvirostris*); peristome inserted at the mouth of the urn, both layers equally

* Papers from the Department of Botany and the Herbarium of the University of Michigan, No. 671. I should like to express my gratitude for the loan of specimens to the following individuals and institutions: Dr. A. J. Grout, Mr. E. B. Bartram, Mr. R. S. Williams and the New York Botanical Garden, Dr. W. R. Maxon and the U. S. National Herbarium.

developed, more or less papillose, basal membrane short, the 16 teeth flat and narrow, undivided or long-fenestrated or divided almost to the base into 2 (or 3) filiform branches which generally persist in pairs, not at all or only very slightly twisted; spores small; operculum conical and rostrate, its cells in straight rows, very rarely obliquely arranged; calyptra mitrate, smooth, soon falling. Type species, *Didymodon rigidulus* Hedw.

It should be pointed out here that *Didymodon* is not at all a natural genus, but a composite of several not-too-closely-related elements grouped together on the basis of rather artificial criteria. *D. recurvirostris*, our only representative of the subgenus *Erythrophyllum* Limpr. was considered generically distinct from *Didymodon* by Loeske, and more closely related to *Leptodontium*, a view for which there is ample evidence. Even though it is the type species upon which Hedwig erected the genus *Didymodon*, *D. rigidulus* is the most closely related to *Barbula* of any of the American species, and is placed there by many authors. *D. tophaceus* has been maintained in the genus *Trichostomum* by many bryologists, and differs from the more typical species of *Didymodon* in several important respects. Finally, *D. giganteus* was withdrawn from *Didymodon* by Schimper and placed by him in the genus *Geheebia*, which he erected for it, a treatment which has been followed widely.

KEY

1. Leaves obsoletely denticulate to strongly dentate at the apex; monoicous; annulus differentiated and deciduous ..... *1. recurvirostris.*
   Leaves entire throughout; dioicous; annulus not differentiated, never deciduous ..... 2.
2. Leaf margin or upper part of lamina composed of 2–3 layers of cells ..... 3.
   Leaf margin and lamina unistratose throughout ..... 4.
3. Leaf linear-lanceolate; costa long-excurrent in an often fragile subula; whole upper lamina bistratose ..... *2. mexicanus.*
   Leaf lanceolate from a broad base; costa disappearing in the opaque apex; margin more thickened than lamina ..... *3. rigidulus.*
4. Cell walls greatly and irregularly thickened, the lumen stellate; plants to 15 cm. long *4. giganteus.*
   Cell walls thickened but not irregularly so, the lumen not stellate; plants 5 cm. long or less ..... 5.
5. Whole plant reddish-brown; known in North America only from far within the Arctic circle ..... *5. rufus.*
   Whole plant some shade of green; of wide distribution in temperate regions ..... 6.
6. Leaves widely ovate-lanceolate; costa ending in the obtusely acute apex ..... *6. trifarius.*
   Leaves lanceolate, the upper lingulate and rounded-obtuse; costa ending well below apex ..... *7. tophaceus.*

Didymodon Hinckleyi Bartr. Bryol 43: 9 f 2: 1-10 MF II 271

1. DIDYMODON RECURVIROSTRIS (Hedw.) Jenn. Man. Mosses. W. Pa. 97. 1913.

Weisia recurvirostra Hedw. Sp. Musc. 71. 1801.
Didymodon rubellus Bry. Eur. Fasc. 29–30, p. 3. 1846.
Barbula rubella Mitt. Journ. Linn. Soc. **8:** 27. 1865.
Didymodon Baden-Powellii Kindb. Ottawa Nat. **5:** 179. 1892 (type seen).
D. canadensis Kindb. in Macoun, Cat. Can. Pl. **6:** 44. 1892 (type seen).
Barbula oenea C. Müll. & Kindb. in Macoun, Cat. Can. Pl. **6:** 55. 1892 (type seen).
Didymodon subruber Kindb. Rev. Bryol. **23:** 20. 1896 (type seen).
D. oenodes C. Müll. & Kindb. Eur. & N. Amer. Bryin. 275. 1897.
Barbula rigens Card. & Thér. Proc. Wash. Acad. Sci. **4:** 305. 1902 (type seen).

Plants densely caespitose in large tufts, bright- to yellowish-green above, rusty or brick red below; stems erect, branched, 1–5 cm. high, radiculose below; leaves when dry flexuous to crisped and curled, when moist somewhat recurved-spreading from the appressed base, narrowly linear-lanceolate, margin narrowly revolute to near the apex, entire except at the extreme apex, which may be clearly dentate to very obscurely denticulate; costa either ending in the apex or more commonly minutely apiculate-excurrent as a pellucid mucro; basal leaf cells elongate, rectangular, hyaline to clear reddish-brown, the upper cells much smaller, densely papillose, obscure, quadrate; perichaetial leaves long sheathing, acute. Monoicous. Seta long, red, slender; capsule erect, oblong-cylindric, reddish-brown at maturity, smooth; annulus fragile, revoluble; peristome teeth 16, united at the base into a very low membrane, linear fron a wider base, nodose-articulate,

reddish, minutely roughened, with the median line only rarely divided; operculum short, obliquely conic-rostrate; spores maturing in summer or early autumn. Type locality, Europe.

ILLUSTRATIONS:—Hedw. Stirp. Crypt. **1**: *pl. 7;* Bry. Eur. *pl. 185;* Wilson Bry. Brit. *pl. 14;* Smith Engl. Bot. *pl. 1438;* Braithw. Brit. Moss-Fl. **1**: *pl. 39A;* Lesq. & James, Manual *pl. 2;* Husnot, Musc. Gall. *pl. 23, figs. 1–11;* Roth, Eur. Laubm. *pl. 17, fig. 8, pl. 19, fig. 2;* Limpricht, Die Laubm. **1**: 546, *figs. a–c;* Broth. Laubm. Fennosk. *fig. 23, E–H;* Mönkem. Laubm. Eur. *fig. 58a;* Dixon & Jameson, Handb. Brit. Mosses (Ed. 3) *pl. 26H;* Casares-Gil, Musgos, Fl. Ibér. *fig. 114, a–h;* Bartram, Hawaiian Mosses *fig. 61;* M. H. M. *pl. 27.*

EXSICCATI:—Aust. Musc. Appalach. 113; Macoun, Canad. Crypt. 157 (as *D. canadensis*); Canad. Musci 161 (as *D. canadensis*), 63, 160; 160b (as *D. subruber*); Canad. Mosses 71; Clements, Format. Colorad. 197; Holzinger, Mosses W. Minn.; Holzinger, Musc. Acro. Bor.-Am. 156, 384; Bartram, Mosses N. Mex. 56A, 83, Mosses So. Ariz. 704, 715, 805, 816, 674; Grout, Musc. Perf. 185; Sull. & Lesq. Musc. Bor.-Am. (Ed.1) 106.

Usually growing on calcareous rocks, walls and soils in rather moist places. A common boreal species found from Greenland west across the Canadian Arctic Archipelago and mainland to Alaska, ranging southward to New Jersey in eastern North America, to Mexico in the west, reaching Iowa in the Central States.

This widespread species is not hard to recognize even when sterile, by the characteristic rusty- or brick-red color of the older parts of the tufts. Under the microscope the leaf apex is unmistakable, because of the several well developed to nearly obsolete teeth, and the minute, pellucid apiculus which presents a strong contrast to the very densely papillose, nearly opaque leaf blade. Most of the western collections of this species, which seems to be very common in the Rocky Mountains, show a plant larger in every way, from the length of the stem to the length of the leaf. The leaves may be more strongly dentate at the apex than the eastern form, often approaching very closely the following variety.

I should like to raise the question as to whether earlier authors have correctly interpreted Hedwig's *Weisia recurvirostra,* in spite of Schimper's unquestioned inclusion of it as a synonym of *D. rubellus.* Hedwig, a very close and shrewd observer, in both his "Descriptio et Adumbratio Muscorum Frondosorum" (p. 20–21) and "Species Muscorum Frondosorum" (p. 71) specifically states that no annulus is differentiated, whereas our plant has a well developed, revoluble annulus. Furthermore, the yellow peristome and the whole facies of the plant illustrated in Hedwig's plate does not suggest our plant as much as perhaps *D. trifarius* or *D. tophaceus.* Finally, from the illustration and description, his plant was apparently dioicous, whereas ours is clearly paroicous or synoicous.

1a. Var. DENTATUS **n. comb.**

D. rubellus var. *dentatus* Schimp. Syn. (I Ed.) 131. 1860.
D. alpigenus (Vent.) Vent. Rev. Bryol. **6**: 53. 1879. (?).

Plants more robust, more loosely caespitose; leaves larger and longer; margin revolute only to about the middle, strongly dentate with pellucid, brown teeth in the upper part.

ILLUSTRATIONS:—Roth, Eur. Laubm. *pl. 19, fig. 13;* Mönkem. Laubm. Eur., *fig. 58d. Pl. 90C.*
EXSICCATI:—Bartram, Mosses So. Ariz. 227B, 239; Cooper & Andrews, Plants of S. E. Alaska 280.

Growing in the same habitats as the species, Alaska to Arizona and New Mexico. This variety is well marked when typical, but intergrades imperceptibly with the species, and occurs in the same geographic range. Consequently, it cannot be given even subspecific rank. Genuine *D. alpigenus,* according to Limpricht (Die Laubmoose Deutschlands, p. 547), is specially characterized, in addition to the dentate leaves, by the very shortly rostrate operculum, whose rows of cells are oblique, twisted to the right. American material, however, agrees with the British specimens discussed by Dixon (Handbook of British Mosses, Ed. III, p. 209) in having an operculum of variable length, often long, with its rows of cells nearly straight.

2. DIDYMODON MEXICANUS Besch. Prod. Bryol. Mex. 28. 1871.

Densely caespitose; stems short, 6–8 mm. long, with innovations arising at the apex of fertile stems; leaves loosely imbricated, lanceolate, cuspidate-acuminate, entire; margin recurved; upper cells quadrate, chlorophyllose, papillose, lower cells rectangular, hyaline. Capsule exactly cylindrical, straight, contracted toward the apex, annulate; operculum conic-rostrate, almost straight, thick, red, peristome gray, its teeth very short, 4–5 nodose, thick, punctulate, closely coherent. [Translated from the original description.] Type locality, Mexico.

The species has not yet been reported from within our range.

2a. Var. SUBULATUS Thér. & Bartr. Bryologist **29**: 1. 1926.

"Apparently dioicous, male flowers not found, female flowers terminal. Plants about 10 mm. high, olive-green strongly tinged with brown, pale brown below and radiculose at extreme base. Leaves erect

and straight or slightly incurved when dry, flexuose-spreading when moist, linear-lanceolate from an ovate and more or less clasping base, subulate acuminate; margins entire, plane above, more or less narrowly reflexed toward the base; upper cells rounded, smooth, 6 to 8 μ in diameter, bistratose for at least 1/3 of the way down, slightly larger and nearly regularly quadrate at the base, usually chlorophyllose throughout; costa strong, 60 to 70 μ wide at base, slightly tapering upward and excurrent into a thick, smooth, more or less flexuose subula, in cross-section near the base showing stereid bands above and below the median guide cells with the surface layers slightly differentiated, in the upper half the stereid bands are reduced to a few cells and the outer layers strongly differentiated." Type locality, Window Trail, Santa Catalina Mts., Pima County, Arizona.

Illustrations:—Bartram, Bryologist **29:** *pl. 1; Pl. 89C.*
Exsiccati:—Bartram, Mosses So. Ariz. 174 (type collection).
Growing on thin soil over dry rocks and ledges. All the material which I have seen was collected by Mr. E. B. Bartram in Arizona in the following localities: Pima County: Spring Canyon, Pima Canyon, Window Trail, Sabino Trail, all in the Santa Catalina Mts.; Agua Caliente. Santa Cruz County: Patagonia Mts. Bartram (l. c.) has made the following comments: "The brownish green color and erect appressed leaves easily mark this plant in the field. It bears some resemblance to *Barbula Bescherellei* Sauerb., but this species is taller, of a brighter green color and has the leaves more flexuose when dry, while under a microscope the unistratose lamina and strongly reflexed margins of the *Barbula* are, of course, perfectly distinct. Collections from various localities in the foothills of the Santa Catalina Mts., and Patagonia Mts., indicate that the new variety is quite generally distributed over this region at elevations between 2500 ft. and 5000 ft. No evidence of vegetative reproduction has been observed and it may be necessary to wait for a favorable season, with frequent and copious rains, to secure the sporophyte." From *D. rigidulus*, this is easily distinguished by the narrower leaves with shorter basal cells, and the long-excurrent costa.

3. Didymodon rigidulus Hedw. Sp. Musc. 104. 1801.

Trichostomum rigidulum C. Müll. Syn. **1:** 570. 1849.
Tortula rigidula Lindb. De Tort. 249. 1864.
Barbula rigidula Milde, Bry. Siles. 118. 1869.
B. Waghornei Kindb. Eur. & N.-Amer. Bryin. 264. 1897 (type seen).

Plants densely caespitose in small tufts, dull to brownish-green, reddish below; stems short, 1–2 cm. long; leaves slightly crisped and twisted when dry, erect-spreading when moist, lanceolate from a broad base, narrowly acuminate to a straight, almost linear point, margin entire, recurved below, thickened above, 2–3-stratose, the lamina itself bistratose toward the apex; costa strong, disappearing in the thickened, opaque leaf apex, rarely somewhat excurrent, papillose; upper leaf cells small, dense, somewhat papillose, quadrate, becoming shortly rectangular, smooth and pellucid at the base; perichaetial leaves with plane margins, otherwise hardly differentiated. Dioicous. Seta 5–10 mm. long, red; capsule erect, short-cylindric, reddish-brown; operculum rostrate from a conic base; annulus not differentiated; peristome inserted at the mouth, teeth very short, split nearly to the base, reddish, papillose, oblique or very slightly twisted; spores maturing in spring. Subspherical propagula are very often present in the axils of the leaves. Type locality, Europe.

Illustrations:—Hedw. Stirp. Crypt. **3:** *pl. 4;* Wilson, Bryol. Brit. *pl. 20;* Bry. Eur. *pl. 176;* Braithw. Brit. Moss-Fl. **1:** *pl. 40B;* Journ. Bot. **9:** *pl. 119, fig. 5;* Husnot, Musc. Gall. *pl. 24, figs, 1–11;* Roth, Eur. Laubm. *pl. 23, fig. 15;* Dixon & Jameson, Handb. Brit. Mosses (Ed. 3), *pl. 27C;* Mönkem. Laubm. Eur. *fig. 62d;* Casares-Gil, Musgos, Fl. Ibér. *fig. 104, a–e; Pl. 90B.*
Exsiccati:—Macoun, Canad. Musci 412; Canad. Crypt. 13 (as *Barbula subgracilis* var. *viridior*); Holzinger, Mosses of W. Minn. (as *B. fallax*); Musc. Acro. Bor. Am. 461; Bartram, Mosses of N. Mex. 99.
Growing on damp calcareous rocks and soil, widespread in the western part of our range from British Columbia south to California, Arizona, New Mexico and Texas. In the east it is very rare, and has a strongly disjunct distribution. However, indisputable material has been seen from Owen Sound, Ontario, and from Newfoundland. Tennessee (Sharp)
Without microscopic examination, this species is apt to be confused with several others. Under the microscope, however, the bistratose leaf margin and upper part of the lamina is very distinctive, even without leaf sections, and serves to distinguish this moss from all species of *Barbula*. The costa is not ordinarily excurrent, but disappears in the rather opaque apex. The presence of groups of stalked, subspherical propagula in the leaf axils is a constant and unmistakable feature of *D. rigidulus*. The broader leaves, shorter costa, longer basal cells, spreading leaves, and presence of propagula furnish distinctive criteria to separate *D. rigidulus* from *D. mexicanus* var. *subulatus*. In the latter plant, the whole upper part of the leaf blade is bistratose, not just the margin. Furthermore, it has another remarkable feature not mentioned

by the authors, the fragility of the long subula of each leaf, formed by the excurrent costa. These tips are broken off in many older plants, much in the same fashion as the leaves of *Dicranum viride* and *Tortella fragilis*.

4. Didymodon giganteus (Funck) Jur. Verh. Zool.-Bot. Wien **21**: 801. 1871.

Barbula gigantea Funck, Flora **15**: 483. 1832.
Tortula gigantea Lindb. De Tort. 250. 1864.
Geheebia cataractarum Schimp. Syn. (Ed. 2) 233. 1876.
G. gigantea Boulay, Musc. de France 395. 1884.

Plants very large, in deep tufts, brownish-green to reddish-brown; stems slightly and irregularly branched, very long, to 15 cm.; leaves crowded, squarrose-recurved when moist, somewhat twisted, but scarcely crisped when dry, gradually lanceolate-subulate from an ovate-lanceolate base, 3–5 mm. long, slightly plicate at the base, sharply carinate above; margin recurved, entire; costa reddish, ending in or just below the apex, papillose; leaf cells unistratose except at leaf insertion where they are bistratose, very strongly and irregularly thickened, the upper cells small, roundish, with a stellate lumen, densely papillose with large, sometimes branched papillae, gradually becoming larger toward the base, rectangular to linear in the middle of the base, with a somewhat sinuose lumen, becoming gradually shorter toward the margin. Dioicous. Fruit unknown. Type locality, Europe.

Illustrations:—Limpricht, Laubmoose **1**: 561, *figs. a–c;* Husnot, Musc. Gall. *pl. 79, figs. 1–6;* Roth, Eur. Laubm. *pl. 30, fig. 10;* Amann, Bryogéog. Suisse, *pl. 15, fig. 2;* Mönkem. Laubm. Eur. *fig. 58f;* Casares-Gil, Musgos, Fl. Ibér. *fig. 115, a–e; Pl. 90A*.

Growing on calcareous rocks in moist places. In Europe where it grows only in the Alps, this species prefers rather wet habitats as waterfalls, springs, and periodically inundated rock ledges.

Mr. R. S. Williams first recognized this species as part of our flora from what is still the only collection known from North America. This collection, which agrees exceedingly well in all respects with European material, was made by T. C. Frye, July 25, 1913, at Aats Bay, Alaska, at an altitude of 1000 feet (No. 931, U. S. Bureau of Soils Kelp Investigation Expedition Alaskan Musci). The greatly but unequally thickened cell-walls produce the conspicuously stellate lumina which may result in the confusion of this species with *Rhacomitrium*, but which will also separate it at once from all other species of *Didymodon*.

5. Didymodon rufus Lor. in Rabenh. Bryoth. Eur. No. 621. 1863.

Tortula rufa Braithw. Journ. Bot. **9**: 293. 1871.
Barbula rufa Jur. Laubmfl. 113. 1882.

Plants densely or loosely caespitose, deeply tufted, dark reddish-brown, dull green at the growing tips; stems long, up to 5 cm., erect, branching; leaves erect-appressed at the base and somewhat recurved above the middle of the leaf when moist, appressed and somewhat twisted when dry, 2.0–2.5 mm. long, gradually acute from an ovate-lanceolate base, sharply carinate above, entire, the margins narrowly revolute; costa strong, not conspicuously tapering, ending in the long apex, papillose on both sides; upper leaf cells strongly thickened, the lumen roundish or elliptic, strongly papillose on both sides, becoming rectangular, smooth and slightly thinner-walled toward the base, especially next the costa. Dioicous. Fruit unknown. Type locality, Europe.

Illustrations:—Husnot, Musc. Gall. *pl. 23, figs. 1–5;* Roth, Eur. Laubm. *pl. 19, fig. 9;* Mönkem. Laubm. Eur. *fig. 60n; Pl. 90D*.

A genuine alpine moss in Europe, where it grows in rock crevices and among fragments of siliceous rock. In the Western Hemisphere, it has been reported from Greenland, and was collected in widely separated parts of Ellesmere Island by the "Fram" Expedition. Among the unidentified material of *Didymodon* in the Herbarium of the New York Botanical Garden I found what is probably the first collection of this species made in North America. This specimen, which is quite characteristic, is from the Mitten collection and bears the legend: "Wellington Channel [between Devon and Cornwallis Islands] Dr. Lyall. Aug. 1853." Although, to date, all the material of this species from North America has been collected far north of the Arctic Circle, it should be looked for on the higher mountains in more temperate regions.

6. Didymodon trifarius (Hedw.) Brid. Bryol. Univ. **1**: 508. 1826.

D. luridus Hsch. in Linn. Syst. Veg. (Ed. 16) **4**[1]: 173. 1826.
Barbula lurida Lindb. Musc. Scand. 22. 1879.
Trichostomum luridum Spruce, Ann. Mag. Nat. Hist. Ser. II. **3**: 379. 1849.

Plants densely caespitose, dull dark- to brownish-green; stems short, up to 1 cm. long, rarely longer; leaves rather stiff, erect-spreading when moist, erect to closely imbricated when dry, hardly twisted, ovate-lanceolate, rapidly contracted to an obtuse apex in the lower leaves and to an acute apex in the longer upper leaves; margin entire, revolute at the base or occasionally nearly to the apex; costa strong, tapering toward the apex, ending in or just below the apex; upper cells small, hexagonal or rounded-quadrate, thick-walled, not papillose, distinct, hardly different at the base; perichaetial leaves scarcely differentiated. Dioicous. Seta about 1 cm. high, red; capsule erect, oblong to short-cylindric; operculum conic, short-rostrate, sometimes oblique, its cells not in oblique rows; peristome teeth not united at the base, short, slender, simple or divided above, irregular, yellowish to reddish, finely papillose; spores maturing in winter. Type locality, Europe.

Illustrations:—Hedw. Stirp. Crypt. **2**: *pl. 28;* Bry. Eur. *pl. 186;* Wilson, Bryol. Brit. *pl. 41;* Braithw. Brit. Moss-Fl. **1**: *pl. 39B;* Husnot, Musc. Gall. *pl. 23, figs. 1–7;* Roth, Eur. Laubm. *pl. 17, fig. 7, pl. 19, fig. 6;* Dixon & Jameson, Handb. Brit. Mosses (Ed. 3) *pl. 26F;* Mönkem. Laubm. Eur. *fig. 62a;* Casares-Gil, Musgos, Fl. Ibér. *fig. 118, a–i;* M. H. M. *fig. 70.*

Exsiccati:—Aust. Musc. Appalach. Suppl. I, 491 (as *Trichostomum*); Macoun, Canad. Musci 64, 162; Holzinger, Musc. Acro. Bor.-Am. 312, 337 (as *D. Hendersoni*), 654 (as *D. rigidulus*).

Growing on usually calcareous rocks and soil. Apparently a boreal species, ranging across the continent from New York to British Columbia, but rather rare in the eastern part of our range. In the west it is more common and has been collected in many localities from British Columbia to Mexico.

This widely distributed species is somewhat variable, but most specimens have a characteristic transparent or pellucid appearance, especially under a lens, somewhat resembling that of *Gymnostomum recurvirostrum*. The peculiar facies will serve to distinguish sterile material from *Barbula fallax*, with which it is sometimes confused in herbaria. From *D. tophaceus* it is easily distinguished by the more acute leaves and longer costa, as well as by the shape of the leaves.

7. Didymodon tophaceus (Brid.) Jur. Laubm. 100. 1882.

Trichostomum tophaceum Brid. Method. Musc. 84. 1822.
Barbula tophacea Mitt. Journ. Linn. Soc. **1**(suppl.): 35. 1859.
Didymodon (?) *diversifolius* Aust. Musc. Appalach. No. 115. 1870 (type seen).
Gymnostomum platyphyllum Kindb. Bull. Torrey Club **17**: 84. 1889 (type seen).
Hymenostylium platyphyllum Broth. in Engler & Prantl, Nat. Pflanzenfam. **1**^{3}: 389. 1902.

Plants densely and deeply caespitose, olive-green or brown, the lower parts often deeply encrusted or embedded in hard calcareous deposits; stems 5 mm. to 5 cm. long; leaves erect-spreading to spreading when moist, incurved when dry, but hardly twisted; lanceolate to lingulate, the upper leaves longer, the apex broadly rounded, obtuse or obtusely-acute; margin revolute, entire; costa strong, brown, ending below the apex; leaf cells thick-walled, shortly rectangular at the base, shorter above, irregularly quadrate to elliptic, crenulate-papillose, very distinct; perichaetial leaves hardly differentiated. Dioicous. Seta 10–15 mm. long, red, erect; capsule erect, elliptic to long-cylindric; operculum straight or obliquely long-rostrate from a conical base, reaching half the length of the urn; its cells in straight rows; annulus not differentiated; peristome inserted at the mouth, extremely variable, the teeth reddish, thickly papillose, irregularly divided, the branches filiform, occasionally somewhat united; spores maturing in winter. Type locality, Europe.

Illustrations:—Bry. Eur. *pl. 175;* Smith, Engl. Bot. *pl. 1707;* Wilson, Bryol. Brit. *pl. 20;* Braithw. Brit. Moss-Fl. **1**: *pl. 39C;* Husnot, Musc. Gall. *pl. 24, figs. 1–10;* Roth, Eur. Laubm. *pl. 20, fig. 15;* Dixon & Jameson, Handb. Brit. Mosses (Ed. 3) *pl. 26I;* Mönkem. Laubm. Eur. *fig. 62f;* Casares-Gill, Musgos, Fl. Ibér. *fig. 116, a–f;* M. H. M. *fig. 71.*

Exsiccati:—Sull. & Lesq. Musc. Bor. Amer. (Ed. 2) 151; Aust. Musc. Appalach. 115 (as *Didymodon* (?) *diversifolius*); Drummond, Musci Amer. 120 (as *D. trifarius*); Macoun, Canad. Musci 506 (as *Gymnostomum platyphyllum*); Holzinger, Mosses W. Minn (as *Trichostomum*); Musc. Acro. Bor-Am. et Eur. 86, 358, 637; Bartram, Mosses So. Ariz. 528.

Growing in calcareous habitats, on wet soil, moist hillsides and cliffs, and in springs and brooks where it may be permanently inundated. A widely distributed boreal species whose range extends across the continent from New York to British Columbia. In eastern North America, where the species is rather rare, it extends southward to Tennessee. In the west it has been collected in many localities from British Columbia to Mexico.

Although forms with acute leaves occur rarely, this clear-cut species may be generally and easily recognized by means of its blunt leaves, in which the costa ends well below the apex. The plants, when growing in water or well supplied with water from below, have the curious ability to build up hard calcareous deposits or "didymodontoliths" of a surprising thickness, in which the plants themselves are permanently fossilized (see the Bryologist **21**: 25–27, 1918 and **28**: 29–32, 1925).

Excluded Species.

Three species which were described originally as members of the genus *Didymodon* must be excluded on the basis of the structure of their costae: *D. craspedophyllus* Card., *D. diaphanobasis* Card., and *D. Hendersoni* Ren. & Card. These species will be treated elsewhere in the Pottiaceae.

Key to the Trichostomeae.

1.	Leaf margins strongly involute	2.
	Leaf margins plane or revolute	3.
2.	Capsules immersed or barely exserted, dehiscing irregularly	2. *Astomum.*
	Capsules exserted on a long seta, operculate; peristome often present	3. *Weisia.*
3.	Hyaline basal leaf cells extending up the margin to form a V	4.
	Hyaline basal leaf cells not extending up the margin farther than at the costa	5.
4.	Sporophyte terminal, or lateral by innovations; leaf margin entire	9. *Tortella.*
	Sporophyte lateral; leaf margin serrate	10. *Pleurochaete.*
5.	Plants small, 2 mm. or less, from an abundant persistent protonema; capsules cleistocarpous, immersed	1. *Aschisma.*
	Plants larger; capsules exserted, operculate	6.
6.	Leaves bistratose throughout; cells of ventral layer larger, strongly mamillose, the dorsal cells smaller, smooth or nearly so	8. *Timmiella.*
	Leaves unistratose (occasionally bistratose at the margins or in spots)	7.
7.	Leaves with a sheathing base often longer than the spreading part; operculun needle-like, much longer than the urn	6. *Rhamphidium.*
	Leaves little or not at all sheathing (except the perichaetial in a few species); operculum not longer than the urn	8.
8.	Leaf margins plane	9.
	Leaf margins more or less revolute	13.
9.	Leaves broadly lingulate; peristome lacking	13. *Hyophila.*
	Leaves oblong to lanceolate, rarely ovate or lingulate	10.
10.	Plants small, calcicolous; leaves entire; peristome lacking	4. *Gymnostomum.*
	Plants larger; leaves often serrulate; peristome present	11.
11.	Peristome of 16 teeth twisted one or more turns, each divided nearly to the base into two filiform prongs	14 ~~15~~. *Barbula.**
	Peristome teeth less well developed, not or scarcely twisted, variously divided and perforate	12.
12.	Leaves serrulate near base	5. *Eucladium.*
	Leaves entire or margins irregular at apex	7. *Trichostomum.*
13.	Leaves serrate, at least near apex	14.
	Leaves entire	16.
14.	Leaves strongly serrate above	15.
	Leaves entire or rarely serrulate near apex; perichaetial leaves little different	16. *Didymodon.*
15.	Leaves unistratose throughout; costa with dorsal stereid band only; perichaetial leaves sheathing	12. *Leptodontium.*
	Leaves bi-tri-stratose above along the margins; costa with both dorsal and ventral stereid bands	15. *Rhexophyllum.*
16.	Leaves 3-ranked, covered with high sharp papillae; sporophyte unknown; only one collection from California	11. *Triquetrella.*
	Leaves many-ranked; papillae of moderate size	17.
17.	Peristome teeth 16, short, straight, variously divided, cleft or perforate	16. *Didymodon.*
	Peristome long, the 16 teeth divided nearly to the base into two filiform divisions, usually strongly twisted and papillose	14. *Barbula.**

* Lacking in *B. rubiginosa.*

ANOECTANGIUM ARIZONICUM Bartr. **sp. nov.**

Dioicum? dense caespitosum, caespitibus fuscescenti-viridibus, opacis. Caulis 5–7 mm. altus, ramosus. Folia sicca valde contorta, apice incurva, humida patentia, oblongo-ligulata, carinata, 1–1.4 mm. longa, obtusa vel rotundata, haud apiculata; marginibus erectis, integerrimis; costa valida, infra apicem folii evanida, dorso papilloso; cellulae superiores obscurae, dense papillosae, 7–9 μ, basilares breviter rectangulares, pellucidae.

Dioicous? Small plants in compact tufts or cushions, dull brownish green; stems 5–7 mm. high, branched. Leaves erect and contorted with incurved apices when dry, erect-spreading when moist, 1–1.4 mm. long, oblong-ligulate, carinate-concave, obtuse or rounded at the apex, not apiculate; margins erect, entire; costa strong, ending below the apex, papillose on the back, *in cross section showing a nearly homogeneous structure with the median guide row poorly differentiated;* upper cells obscure, densely papillose, rounded, not incrassate, 7–9 μ, short rectangular, smooth and pellucid toward the base. Sporophyte not seen. *Plate* 91 (in Part 4).

Arizona: ledges back of Daly's mine, White House Canyon, Santa Cruz Co. Alt. about 6,500 ft.

The obtuse or rounded leaves without any suggestion of an apiculus and the costa ending below the apex clearly separate this species from *A. euchloron.* The perichaetial flowers appear to be lateral near the base of the branches but the generic position of the species will remain open to question until the fruiting characters are available. Easily distinguished from *A. obtusifolium* by the costa structure.

PLATES

PLATE 69. Left, *Encalypta vulgaris*. 1, habit sketches × 1; 2, habit sketch typical of many plants of var. *mutica* × 1; 3, 4, capsules moist and dry and calyptra × 20 (Note: the calyptra is typical of plants growing in dry crevices. The surface varies from densely scabrous to nearly smooth or papillose only at the tip as in B6); 5, spores × 300; 6, typical leaves of the species × 20; 7, leaf and leaf apices of var. *apiculata* × 20; 8, 9, leaves of var. *mutica* × 20; 10, upper median cells × 300; 11, basal median cells × 300.

B. Encalypta rhabdocarpa. 1, habit sketch × 1; 2, leaves and leaf apices × 20; 3, upper median cells × 300; 4, basal median cells × 300; 5, capsules moist and dry × 20; 6, calyptra and clavate beak, × 20; 7, peristome teeth × 150; 8, 9, teeth showing variations in the preperistome × 300; 10, spores × 300.

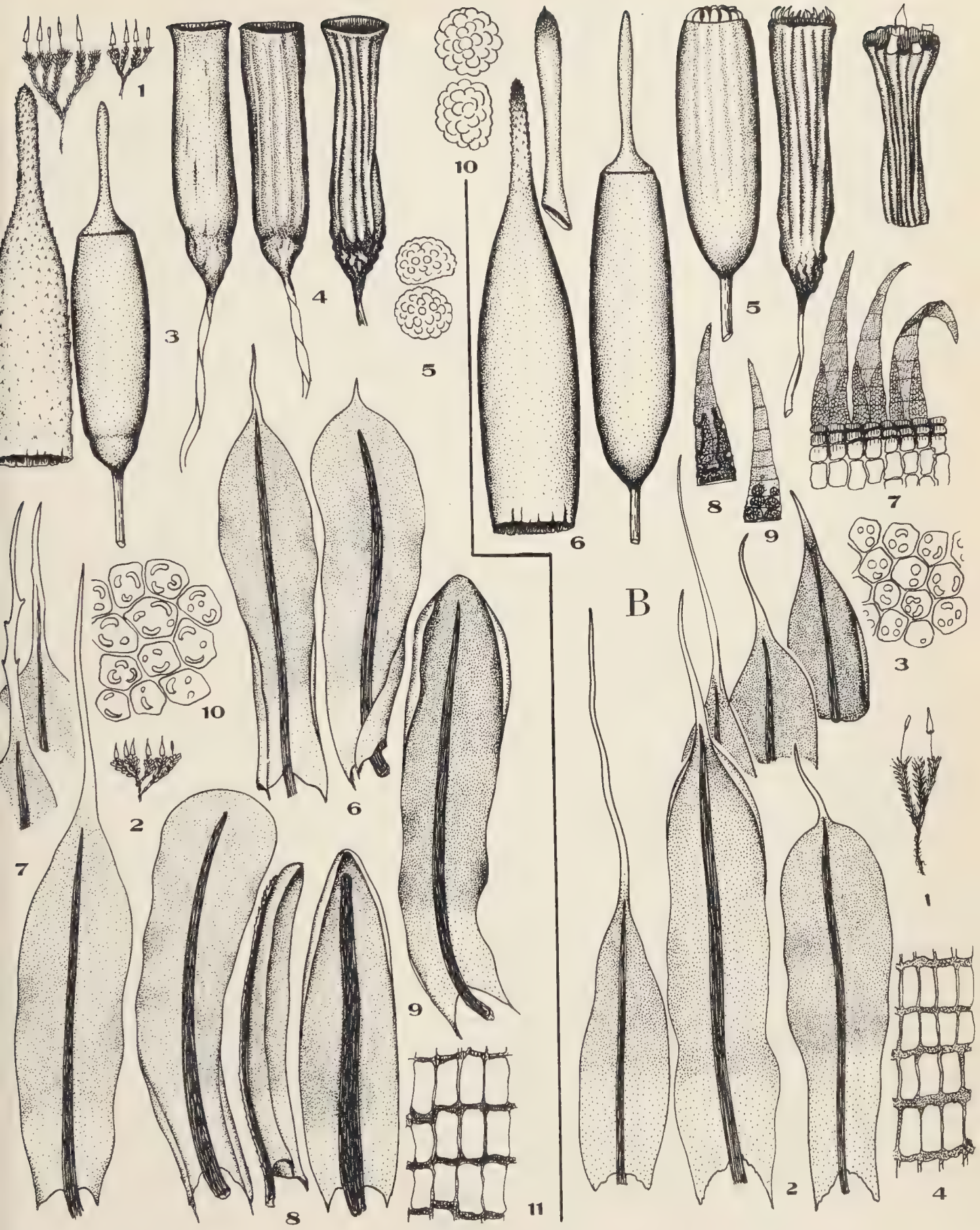

PLATE LXIX.

PLATE 70. *A. Encalypta apophysata.* 1, habit sketch × 1; 2, leaves and apices × 20; 3, upper median cells × 300; 4, basal median and marginal cells × 300; 5, capsules moist and dry × 20; 6, peristome teeth showing type with fine papillae × 75; 7, peristome teeth showing type with coarse papillae × 150; 8, spores × 300; 9, calyptra × 20; 10, calyptra fringe × 150.

B. Encalypta brevicolla. 1, habit sketch × 1; 2, leaves × 20; 3, upper median cells × 300; 4, basal median and marginal cells × 300; 5, spores × 300; 6, peristome teeth (After Coker, from Bull. Torr. Club **45**: *pl. 14B.*), 7, capsule × 10.

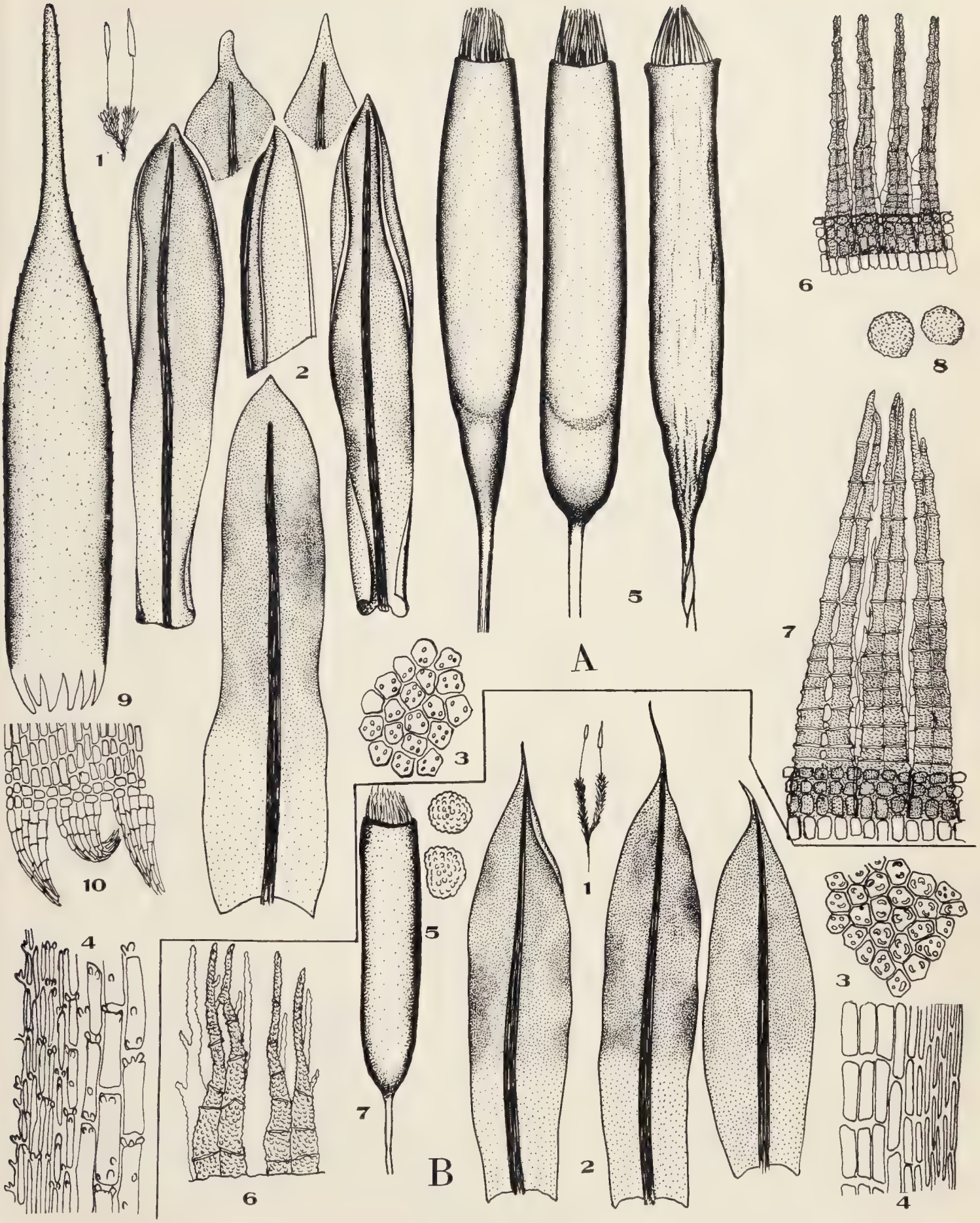

PLATE LXX.

PLATE 71. *A. Encalypta streptocarpa.* 1, habit sketch × 1; 2, dry habit sketch × 2; 3, leaves × 20; 4, upper median cells × 300; 5, basal median and marginal cells × 300; 6, capsules, moist and dry × 20; 7, calyptra × 20; 8, peristome teeth from European specimen × 150; 9, 10, portions of the teeth showing papillae × 600; 11, spores × 300.

B. Encalypta ciliata. 1, dry capsule and calyptra × 20; 2, calyptra fringe × 150; 3, peristome teeth × 150. (Note: many plants have teeth with very fine papillae in vague parallel lines and some have scattered coarse papillae interspersed with fine granular papillae); 4, spores × 300.

C. Encalypta alpina. 1, habit sketch × 1; 2, leaves × 20; 3, capsules, moist and dry × 20; 4, calyptra × 20; (Note: in many plants the calyptra is shorter); 5, outline of a young calyptra showing incurved fringe × 10; 6, spore × 300; 7, portion of calyptra fringe showing undifferentiated basal cells × 150.

PLATE LXXI.

PLATE 72. *Encalypta procera.* 1, habit sketches × 1; 2, portions of stems showing dry habit × 2; 3, leaves and leaf apices × 20; 4, upper marginal cells × 300; 5, upper median cells showing two types of papillae × 300; 6, basal median and marginal cells × 300; (Note: in many plants the papillae on the basal cells are lacking); 7, brood bodies, showing the manner in which they are formed on the tips of rhizoid-like outgrowths × 75; 8, dry capsules × 20; 9, calyptra and moist capsule × 20; 10, peristome teeth × 150; 11, portions of peristome teeth showing variations in the papillae × 600; 12, spores × 300; 13, cross section of the costa, × 150; 14, cross section of the stem × 150 (Note: the stem is predominantly triangular in section); 15, cross section of the stem of *E. contorta* (*streptocarpa*) × 150.

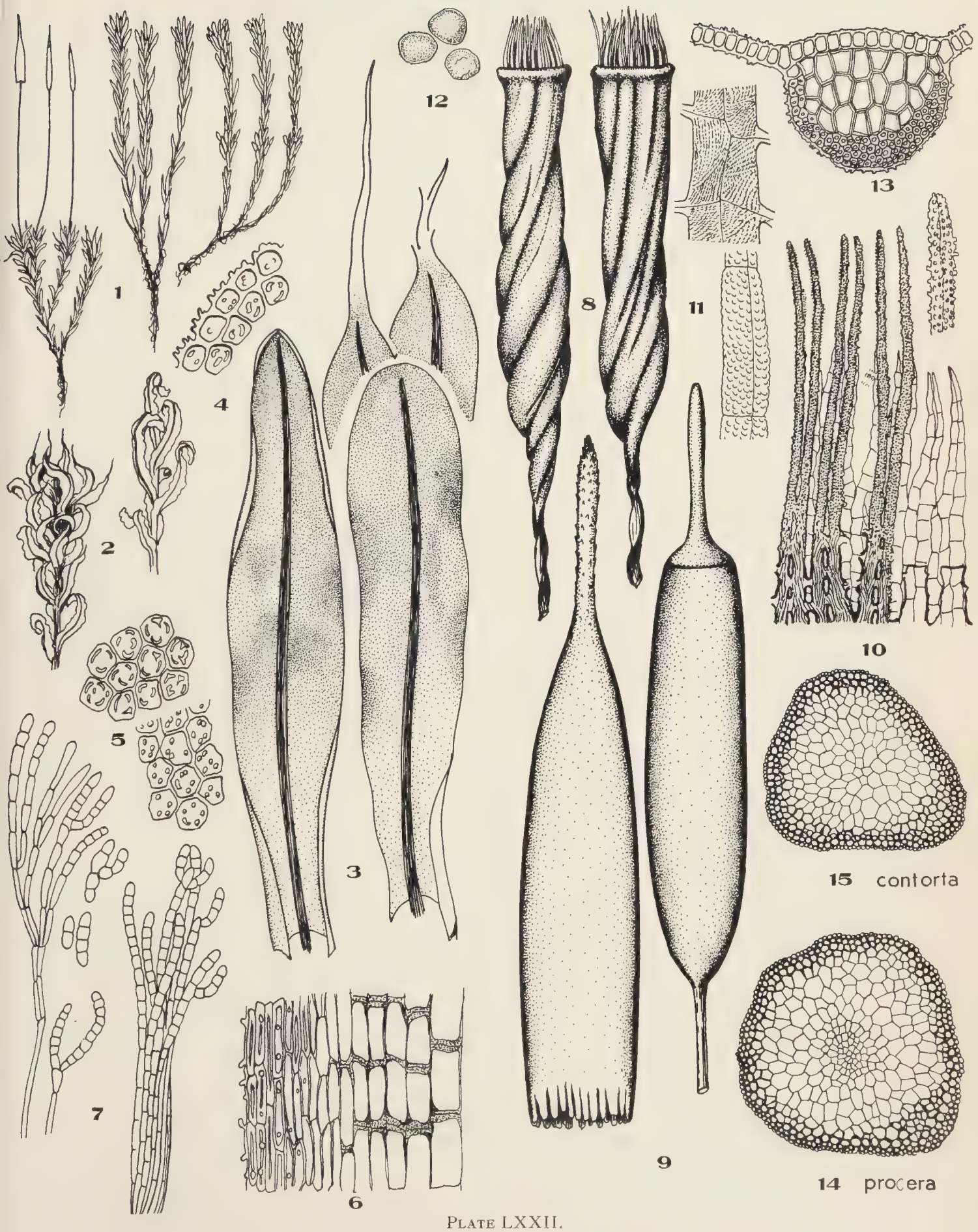

PLATE LXXII.

PLATE 73. A. *Buxbaumia Piperi*. 1, plants × 1; 2, capsules, showing the outline from above × 1; 3, leaf × 160; 4, peristome × 160; 5, vertical section through upper capsule and peristome × 100, A, large cells forming the pseudo annulus, B, inner and outer peristome, C, outer wall of capsule (from Bull. N. Y. Bot. Gard. **2**: *pl. 39*); 6, antheridial plant × 300; 7, antheridium × 300; 8, stoma × 285. Insert, photographs of (a) *Buxbaumia aphylla* and (b) *B. subcylindrica*, both about × 1.

At right. *Anoectangium euchloron*. A, plant × 1¼; B, leaf × 56; C, leaf apex × 312; D, capsule × 15. (From Engler and Prantl, Natul. Pflanzenf. (Ed. 2) **10**: 245, *f. 201*, by permission.)

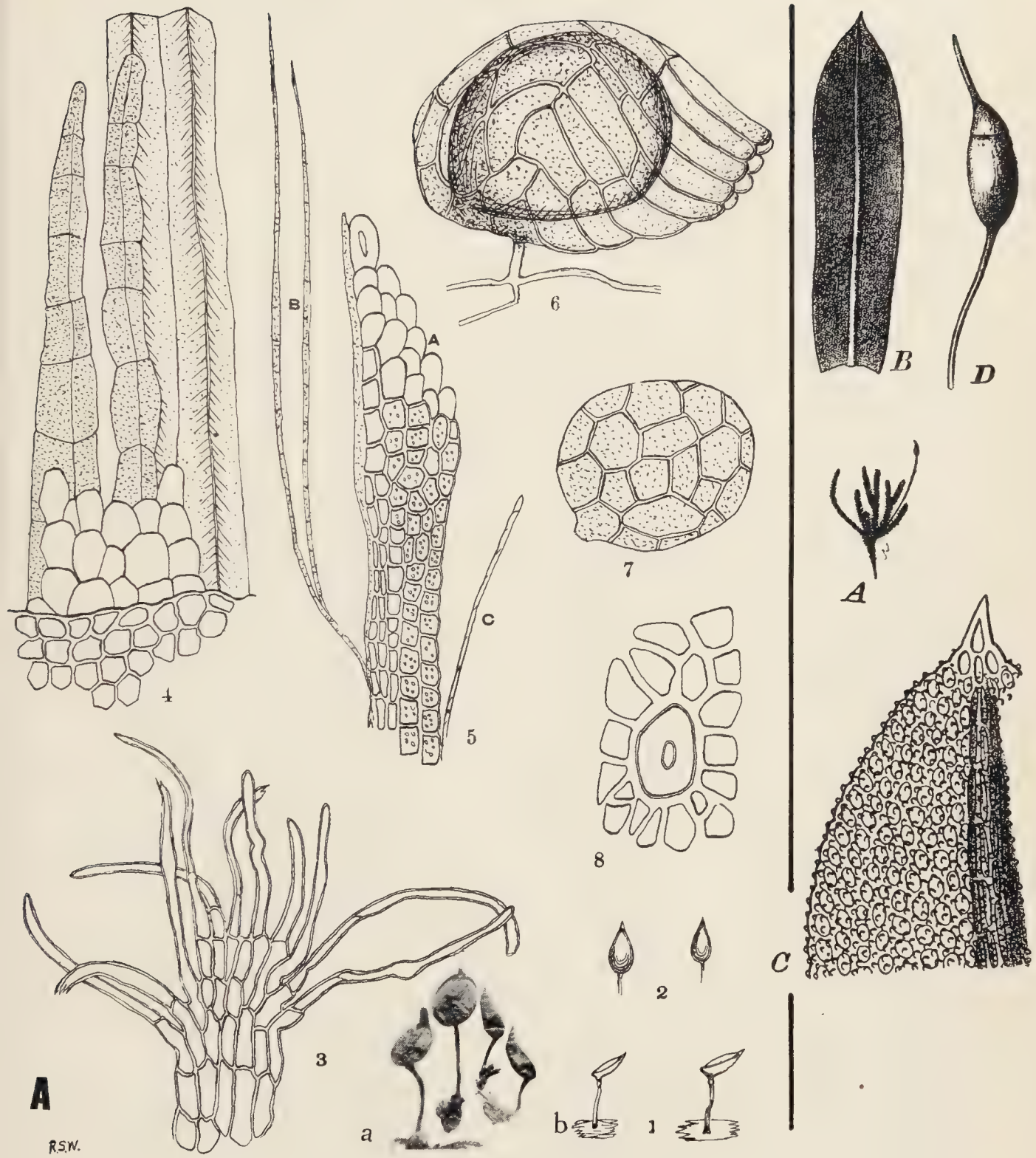

PLATE LXXIII.

PLATE 74. N. *Anoectangium Peckii* (from Sull. Icones Musc. Suppl. *pl. 25*). 1, plant × 1; 2, plant enlarged; 3, leaves and leaf sections; 4, leaf base and apex showing cell structure; 5, antheridial bud, perigonial leaf, paraphysis and antheridium; 6, perigonial leaf.

A, B, C′. *Anoectangium compactum* (from Limpricht, Laubmoose **1**: 245. *f. 92*). A. Portion of plant × 24; B, leaf × 60; C, cross section of leaf × 400.

D. *Gymnostomum calcareum* (from Dixon, Handb. Brit. Mosses (Ed. 2) *pl. 31*). 1, leaf; 1a, leaf apex; 1c, median marginal cells; 1bc, basal marginal cells.

C. *Gymnostomum tenue* (from Dixon, l. c.). 1, leaf; 1a, leaf apex; 1c, median marginal cells; 1bc, basal marginal cells; 5, capsule mouth and operculum.

PLATE LXXIV.

PLATE 75. *Anoectangium obtusifolium* (A–I, from Orcutt's Texas plants no. 7161). A, moist plant × 6; B, comal leaf × 40; C, stem leaf × 40; D, upper leaf cells and margin × 200; E, lower leaf cells and margin × 200; F, lower leaf cells toward costa × 200; G, cross section from lower third of leaf × 200; H, cross section from upper third of leaf × 200; I, cross section from middle third × 200.

J–P. (from Bro. Arsène's Mexican plants). J, plants × 4; K, dry plants × 4; L, leaves × 30; M, cross sections of leaf near middle and towards apex × 300; P, antheridial bud × 30; O, capsules × 20; N, perichaetial leaves and base of seta × 30. (A–I by E. B. Bartram; J–P by Dr. Seville Flowers.)

1–14, *Anoectangium Sendtnerianum* var. *tenuinerve* (from Bryologist **15**: *pl. 3*). 1, shoots of *f. xerophila* × 13; 2, cross section of stem × 175; 3–7, stem leaves × 13; 8, cross section near base of leaf × 175; (5) guides, (3, 4) stereid cells; 9, cross section of costa from middle of leaf × 175, parts as above; 10, cross section of upper leaf, parts as above; 11, upper leaf cells × 175; 12, basal cells × 175; 13, 14, archegonial buds × 13.

PLATE LXXV.

PLATE 76. A–H. *Weisia glauca.* A, moist plant × 1; B, capsule and lid × 17; C & D, Lower stem leaves × 17; E, middle stem leaf × 17; F, upper stem leaf × 17; G, part of cross-section from upper half of leaf × 240; H, two peristome teeth from inside × 250.

I–S. *Weisia Andrewsii.* I, moist plant × 1; J & K, lower stem leaves × 8; L & M, upper stem leaves × 8; N, part of cross-section from upper half of leaf × 240; O, outer perigonial leaf × 42; P, inner perigonial leaf × 42; R, capsule × 8; S, part of peristome from inside × 240.

Right. *Hymenostomium ligulaefolium.* A, moist plant × 8; B, part of cross-section from upper half of leaf × 385; C, stem leaf × 65; D, one side of leaf base × 385.

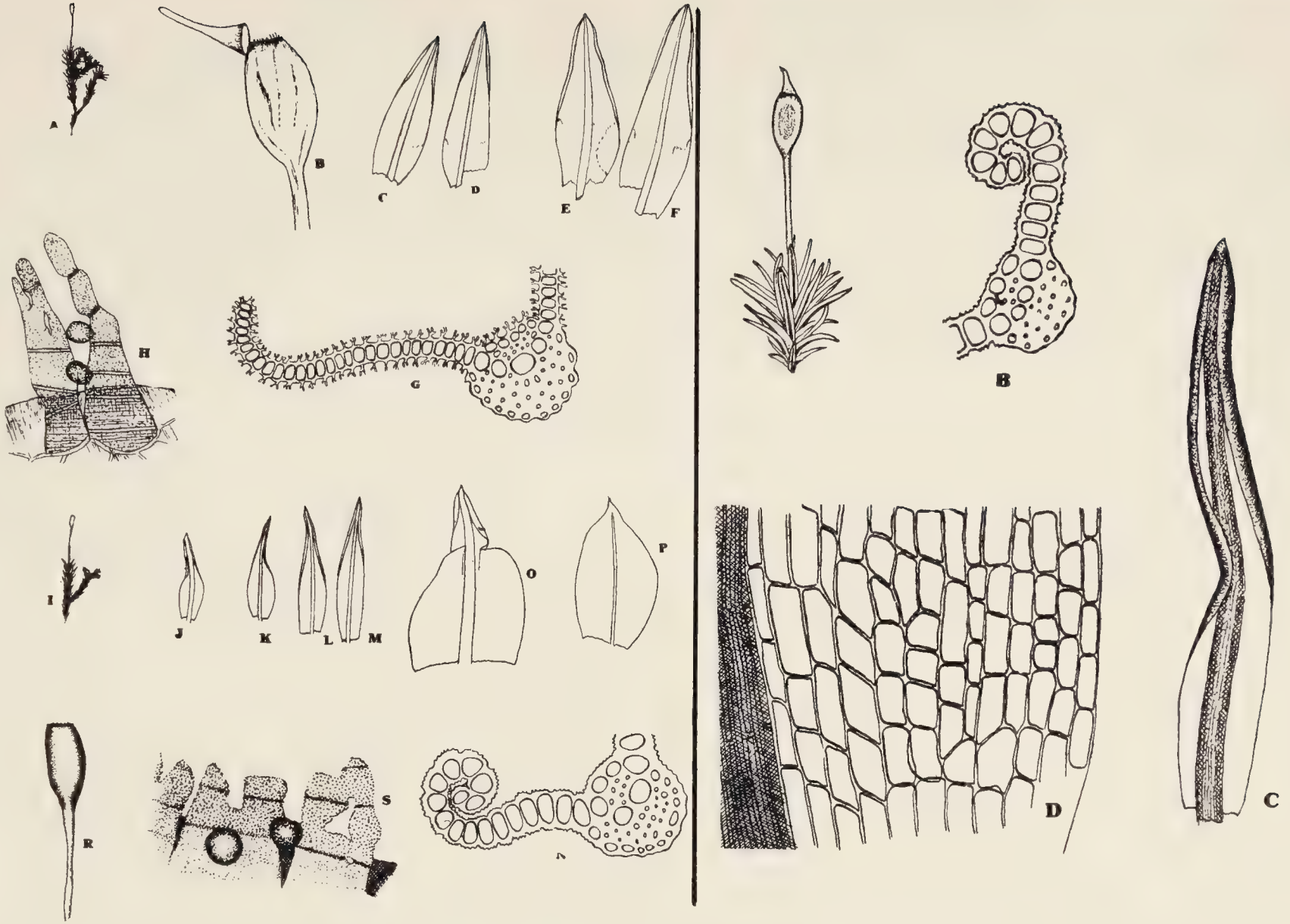

PLATE LXXVI.

PLATE 77. A. *Astomum Muhlenbergianum* (from Sull. Icones Musc. *pl. 11*). 1, plants × 1; 2, fruiting plant enlarged; 5, 6, comal leaves; 7, upper part of leaf; 8, basal areolation; 10, portion of cross section of leaf; 12–14, capsules; 15, capsule in longitudinal section; 16, capsule, calyptra and perichaetial leaves; 17, 18, calyptrae; 19, spore. (Nos. 6, 7, do not show.)

B. *Astomum ludovicianum* (from Sull. l. c. *pl. 12*). 1, plant × 1; 2, plant much enlarged; 4, 5, leaves; 6, parts of leaves; 8, cross section of upper leaf; 9, basal areolation; 10, 11, 12, capsules; 13, longitudinal section of capsule; 14, calyptra; 15, spore.

PLATE LXXVII.

PLATE 78. A. *Tortella flavovirens* (from Bry. Eur. *pl. 172*). 6, 7, 8, Leaves much enlarged; 7x, 7x′, cross sections of leaf; 7a, 7b, leaf apex and base showing cells; 5, lower leaf; 9, 10, perigonial leaves; 11, antheridia and paraphyses; 13, perichaetial leaf; 16, peristome.

B. *Weisia microstoma* (from Bry. Eur. *pl. 16*). 7, Leaf much enlarged; 6a, 6b, leaf apex and base showing cells; x, ½ cross section of leaf; 9, perichaetial leaf; 11, 12, 13, capsules; 15, capsule mouth showing membrane; 16, 17, annulus cells; 18, spores. (No. 7 not shown.)

C. *Weisia tortilis* (from Bry. Eur. *pl. 18*). 5, 10, Leaves; 5a, 5b, leaf apex and base showing cells.

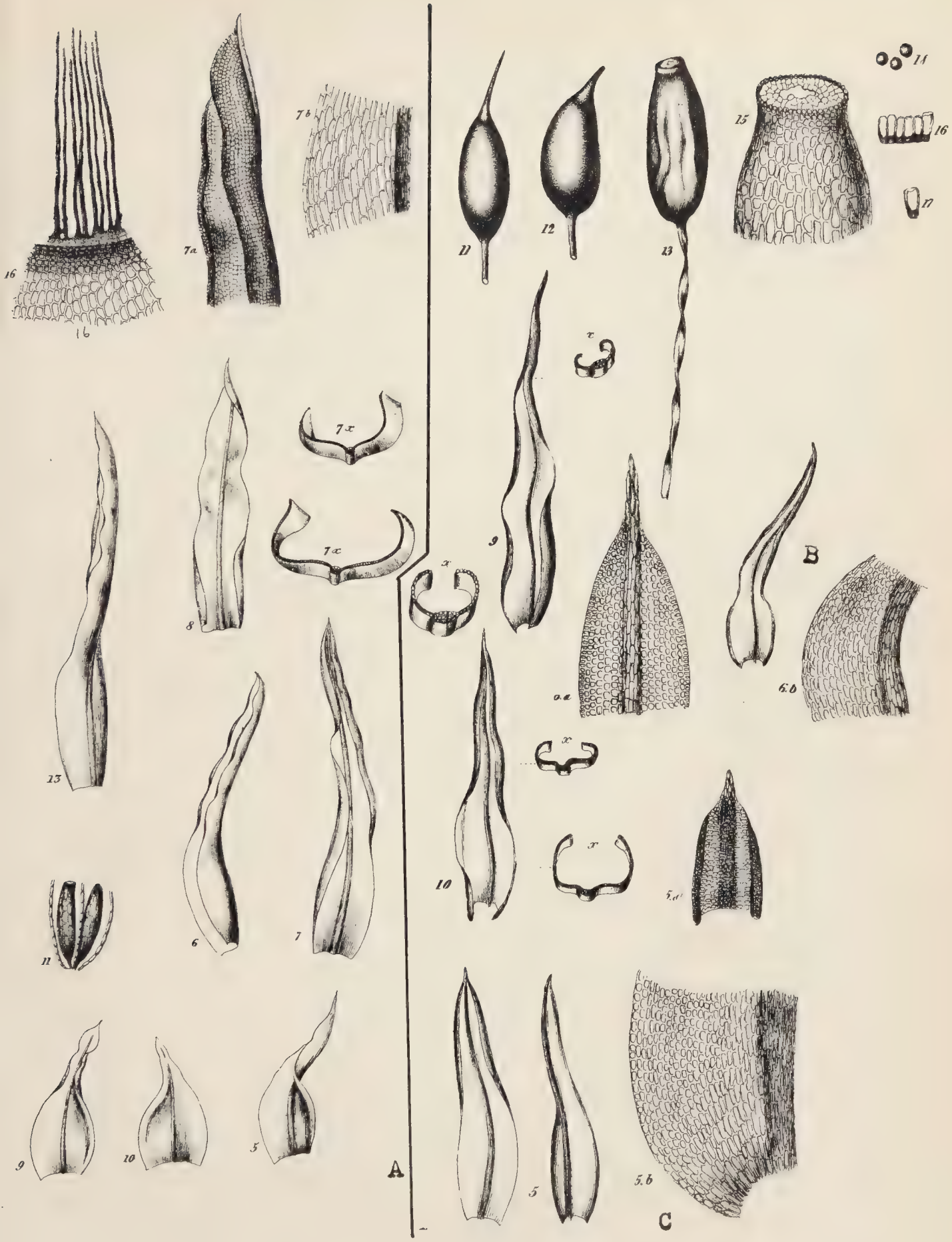

PLATE LXXVIII.

PLATE 79. A. *Ramphidium macrostegium* (from Sull. Icones Musc. Suppl. *pl. 22*). 1, plants × 1; 2, plant much enlarged; 3, leaves; 4, cross section of upper portion of leaf; 5, leaf base and apex showing cell structure; 6, 7, capsule, operculate and deoperculate; 8, mouth of capsule with peristome; 9, peristome.

C. *Eucladium verticillatum* (from Braithw. Brit. Moss Fl. **1**: *pl. 35*). a, plant × 1; a*, portion of plant enlarged; 1, leaf much enlarged; 1aa, leaf apex and 1ab, leaf base enlarged to show cell structure; b, male plant × 1; 2, perichaetial leaf; 4, perigonial leaf, antheridium and paraphysis; 5, capsules; 8, peristome teeth.

L. *Campyloppus Schimperi* (from Dixon, Handb. (Ed. 3) *pl. 11*). 1, leaf enlarged and basal leaf cells much more enlarged; 1a, leaf apex; 1c, upper leaf cells; 1x, portion of cross section of costa showing lack of stereid cells.

PLATE LXXIX

PLATE 80. A. *Timmiella anomala* (from Bry. Eur. *pl. 169*). 1, Plant × 1; 4, 5, 6, leaves much magnified; 5a, 5b, leaf base and apex showing cells; 5x, 5x′, cross sections of leaf; 7, perichaetial leaf; 8, antheridial buds; 10–12, perigonial leaves; 13, antheridia and paraphyses; 14, archegonia in place and innovation; 15, perichaetial leaves; 16, 17, operculate capsules; 18, calyptra; 19, operculum; 20, deoperculate capsule; 21, 22, 23, peristomes; 24, annulus; 25, spores.

B. *Timmiella flexiseta* (from Bry. Eur. *pl. 171*). 4, 5, Plants enlarged; 2b, male plant; 11, deoperculate capsule and seta; 12, peristome teeth; 13, annulus; 14, spores.

1
17
16
20
18
19
21
22
25
24
23
5b
5a
5a'
13
14
11
12
15
14
13
7
10
11
12
8
4
4
5
6
6
A
B
3
4
2b

PLATE LXXX.

PLATE 81. A. *Trichostomum cuspidatissimum* (from Proc. Wash. Acad. **4:** *pl. 13, figs. 4*). 4a, plants × 1; 4b, b, leaves × 35; 4c, basal leaf cells × 135; 4e, cells of leaf apex × 135.

B. *Barbula Johansenii* (from Report of the Canadian Arctic Expedition, **4:** 15E, *figs 1–2*). 1, plant × 19; 2, outer perichaetial leaf × 2; 8, 9, inner perichetial leaves × 32; 3, stem leaf × 32; 4, 5, cross sections of lower and middle parts of stem leaf × 210; 6, 7, cross sections of upper part of leaf and of excurrent part of costa × 210; 10, apex of costa broken off and starting new growth × 50; 11, basal cells of stem leaf × 210; 12, median cells × 245.

C. *Barbula rubiginosa* (from Jour. Linn. Soc. **8:** *pl. 5*). 1, plants × 1; 2, leaf much enlarged; 3, cross section of the same; 4, perichaetial leaf; 5, operculate capsule.

D. *Pleurochaete squarrosa* (from Braithw. Brit. Moss Fl. **1:** *pl. 33*). a, c, plants × 1; 1, leaf; 2, perichaetial leaf; 1x, cross section of leaf; 7, peristome.

E. *Tortella nitida* (from Braithw. l. c., *pl. 37*). a, b, plants × 1; 1, leaves; 1x, cross section of leaf; 4, antheridial bud, antheridia and paraphyses, and perigonial leaf; 5, old deoperculate capsule; 8, peristome teeth.

D
1x
c
7
a
2.
1.
Pleurochæte squarrosa
2
3
4
5
1
10
11
B
7
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9
12
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1.
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C
4b
4e
4b
4d
4a
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J. Thirion del.
8
b
a
5
4.
1
1x.
Mollia nitida.
E

PLATE LXXXI.

PLANT 82. *A. Weisia jamaicense*, 1, plants moist and dry × 1; 2, dry plant × 3; 3, moist plant × 3; 4, leaves × 30; 5, leaf apices × 150; 6, cross sections of leaf × 300; 7, basal leaf cells × 300; 8, upper leaf cells × 300; 9, operculate capsules; 10, deoperculate capsule, all × 20; 11, peristome teeth × 300.

B. Astomum phascoides. 1, plants × 1; 2, plants × 3; 3, leaves × 30; 4, cross sections of leaf; 5, leaf apices × 150; 6, upper leaf cells × 300; 7, basal leaf cells × 300; 8, capsules × 20. (All drawn by Dr. Seville Flowers.)

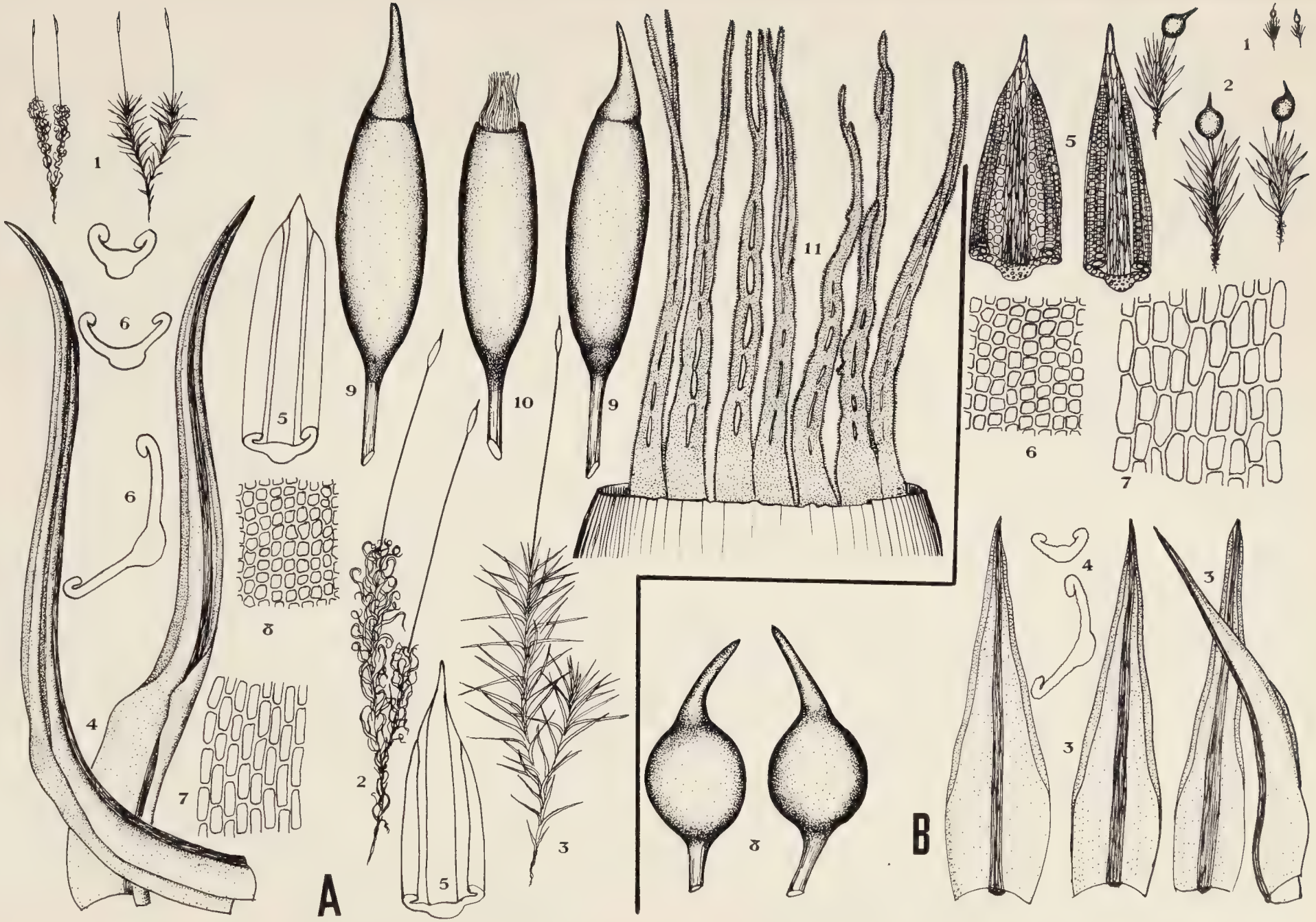
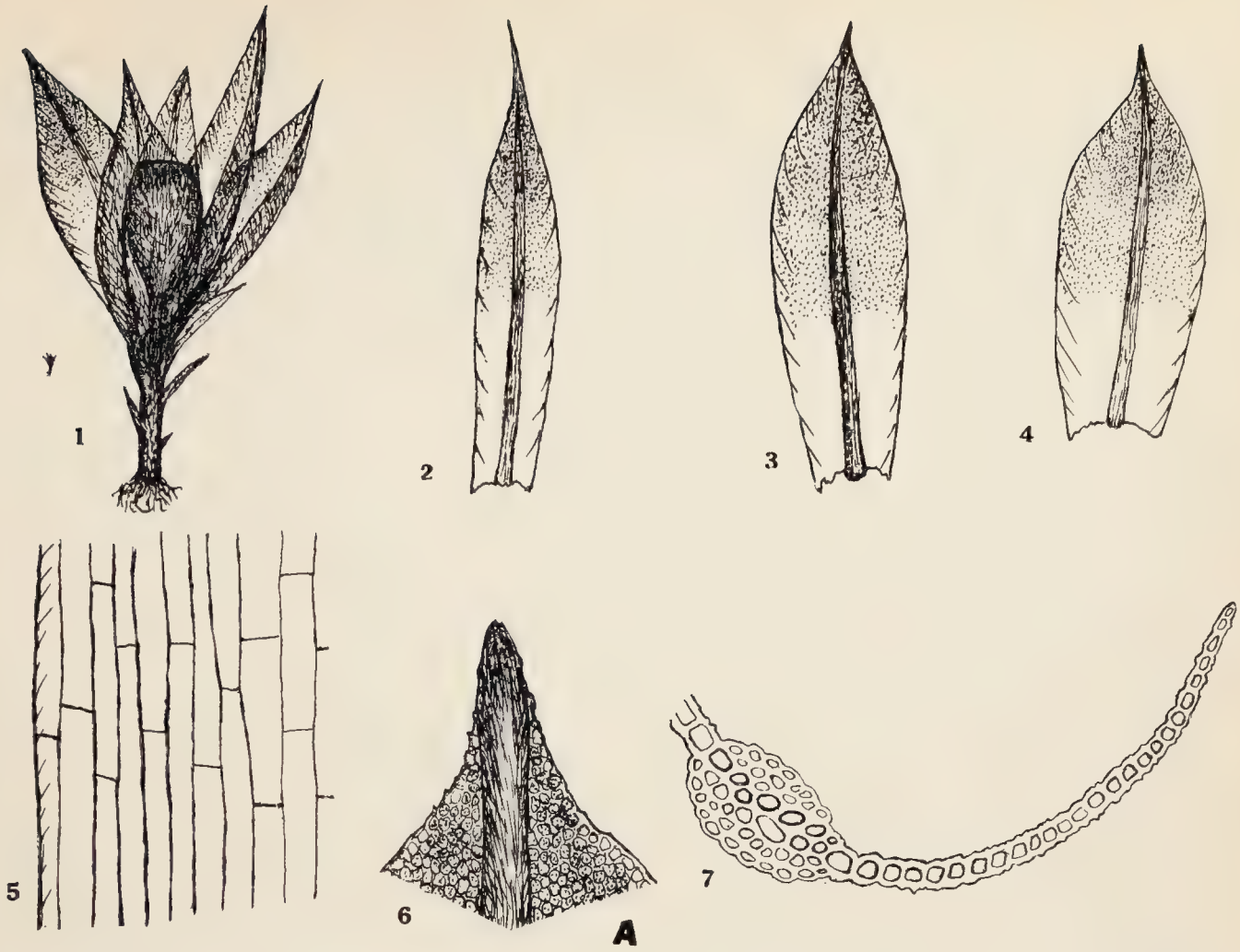


PLATE LXXXII.

PLATE 83. A. *Aschisma kansanum.* 1, Plant about × 1 and × 25; 2, 3, perichaetial leaves × 35; 4, upper stem leaf × 35; 5, cells near basal angles × 270; 6, apex of upper leaf × 270; 7, cross section leaf near middle × 270. (Drawings by R. S. Williams.)

B. *Timmiella anomala* (from Limpr. Laubm. **1**: *f. 73*). *a*, Cross section of leaf near middle; *b*, near base.

C. *Triquetrella californica.* 1, Portion of stem with leaves × 16; 2, leaves × 24; 4, base of leaf × 240; 5, 7, apices × 240; 6, median cells × 240. (Drawings by Seville Flowers from type collection.)



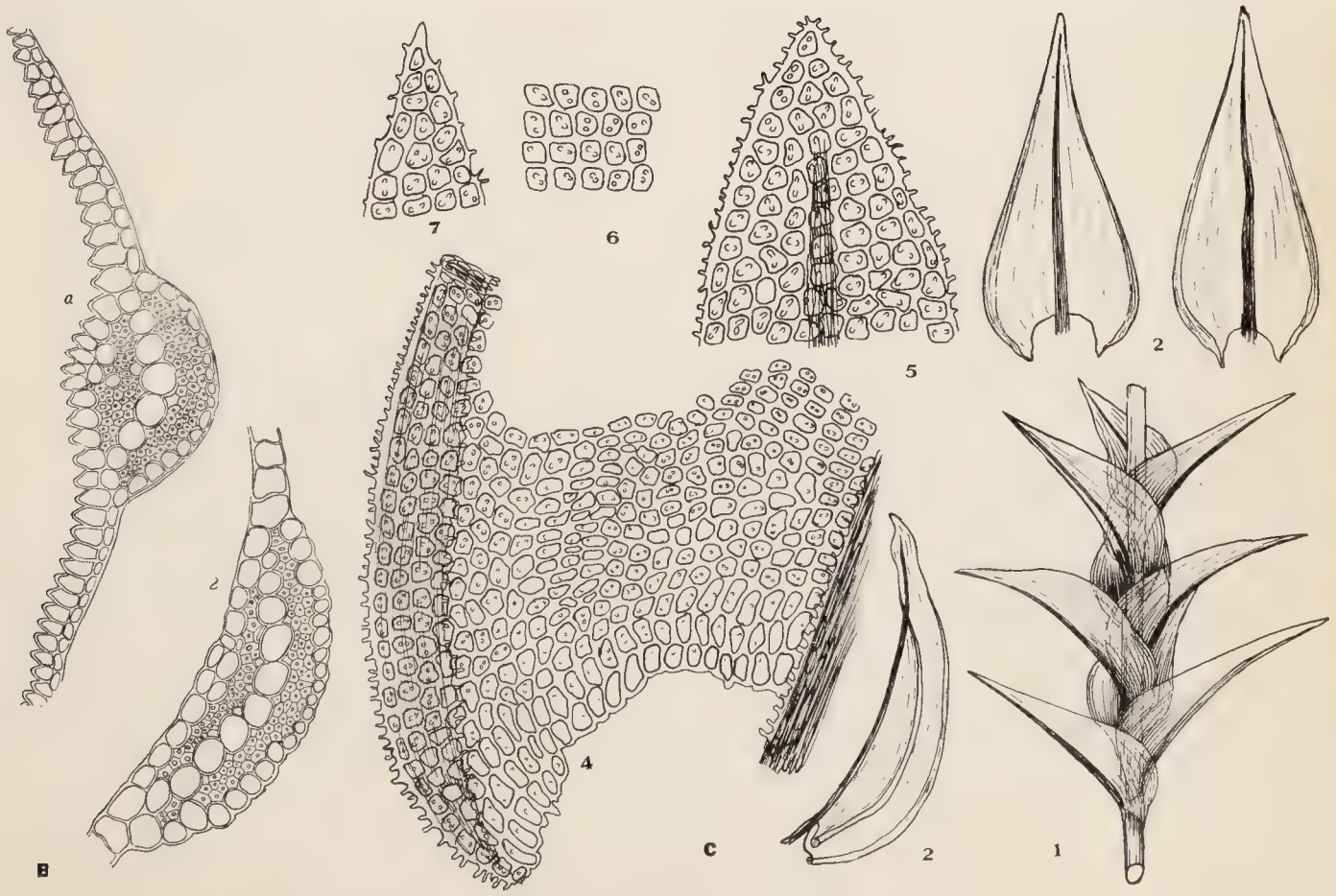
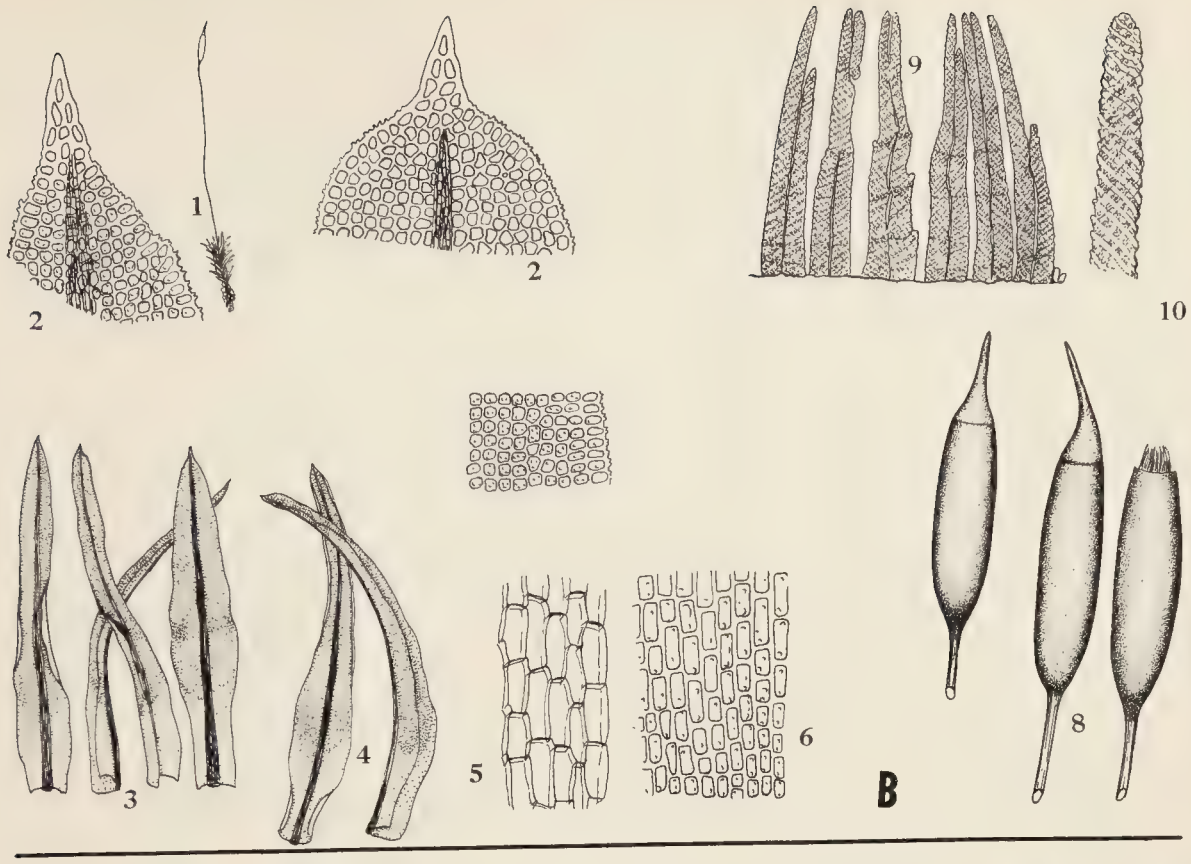


PLATE LXXXIII.

PLATE 84. *A. Tortella inclinatula.* 1, plants moist and dry × 2/3; 2, lower leaves × 20; 3, upper leaves × 20; 4, perichaetial leaves × 20; 5, leaf apices × 67; 6, base of seta with perichaetial leaves and a few stem leaves showing the difference in position when dry × 13; 7, 11, basal marginal cells × 200; 8, 10, median marginal cells showing how the elongated cells extend up the margin × 200; 9, upper cells × 200; 12, operculate capsule with unusually long operculum × 13; 13, deoperculate capsule × 13; 3 peristome teeth × 100.

B. Trichostomum spirale. 1, plant × 2; 2, leaf apices × 200; 3, leaves × 20; 4, upper and perichaetial leaf × 20; 5, inflated basal cells × 200; 6, cells near base × 200; 7, upper median cells × 200; 8, capsules × 13; 9, peristome teeth × 200; 10, single tooth × 400 (all drawn by Dr. Seville Flowers).



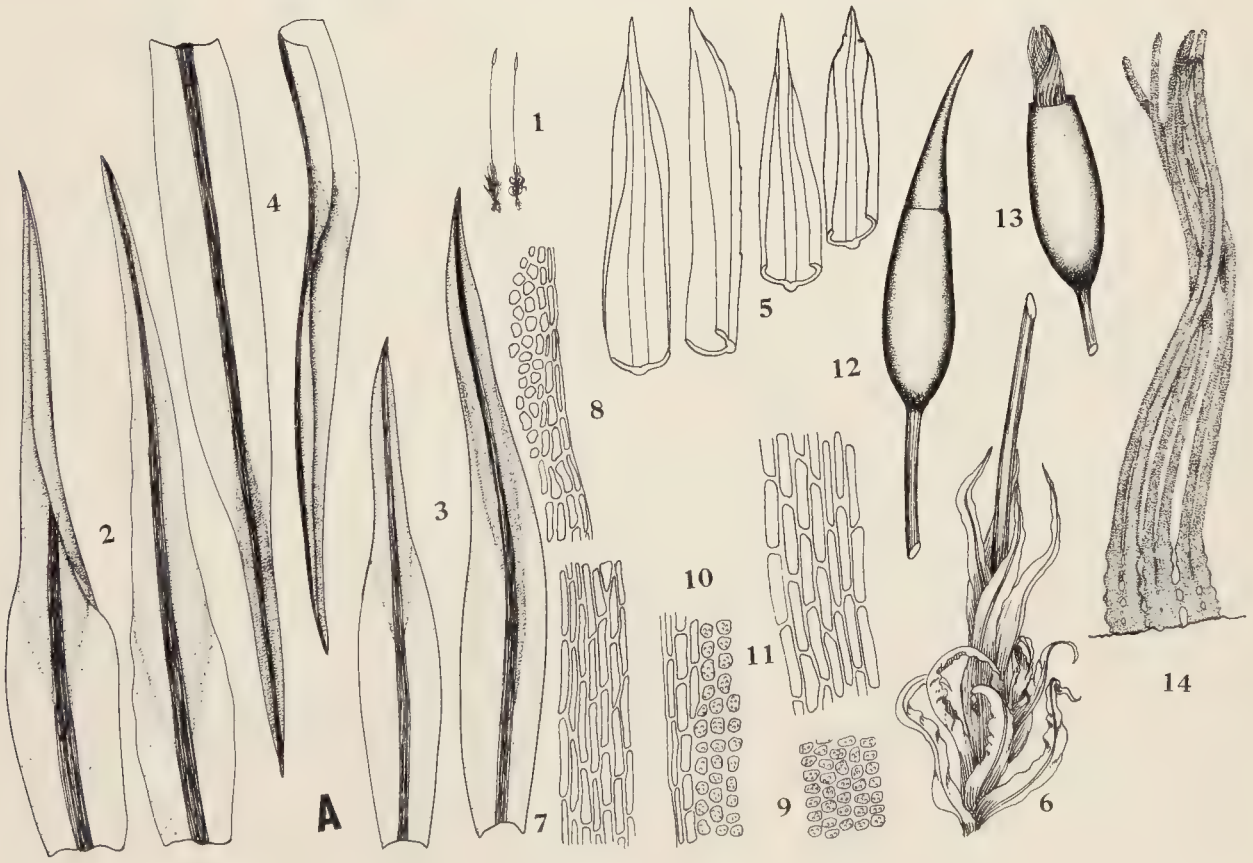


PLATE LXXXIV.

PLATE 85. A. *Lepodontium excelsum* (from Sull. Icones Musc. *pl. 32*). 1, Plant × 1; 2, portion of same enlarged; 3, 4, leaves; 8, 9, 10, 11, cross sections of leaves; 12, base of leaf showing cell structure; 13, apex of same.

B. *Hyophila tortula* (from Sull. Icones Musc. Suppl. *pl. 21*). 1, Plant × 1; 2, plant enlarged; 3, leaves; 4, cross section of leaf; 5, apex of leaf showing cell structure; 12, basal margin of same; 6, 7, 8, capsules; 9, base of seta with archegonia; 10, calyptra attached to columella; 11, annulus.

PLATE LXXXV.

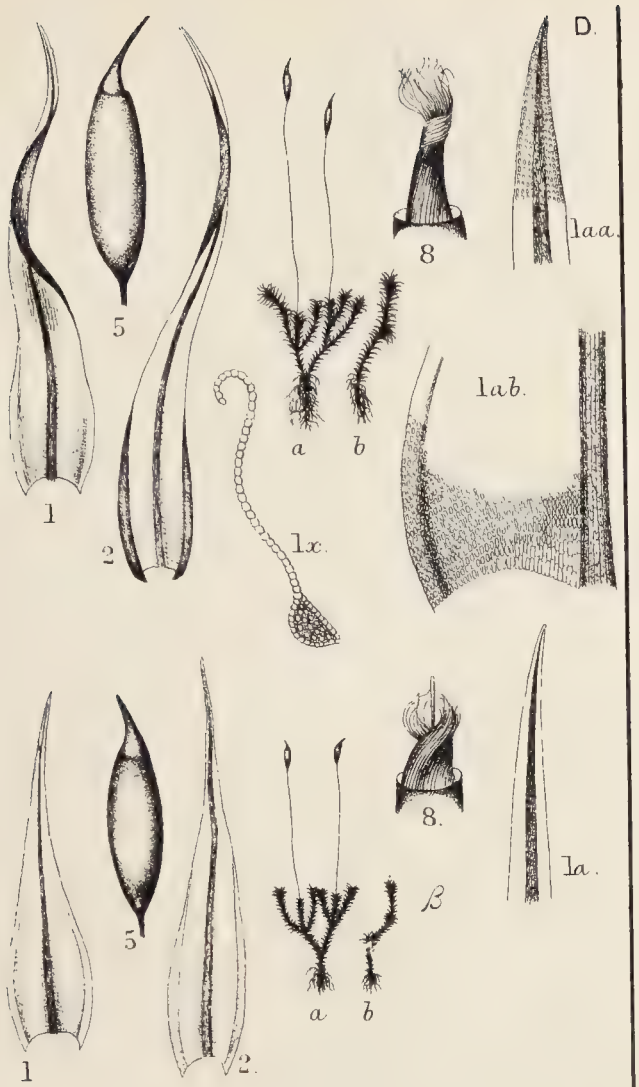
PLATE 86. D. *Barbula cylindrica* (from Braithw. Brit. Moss Fl. **1**: *pl. 40*). a, b, Female and male plants respectively × 1; 1, leaf magnified; 1aa, apex of same; 1ab, base of same; 2, perichaetial leaf; 1x, cross section of leaf; 5, capsule; 8, peristome.

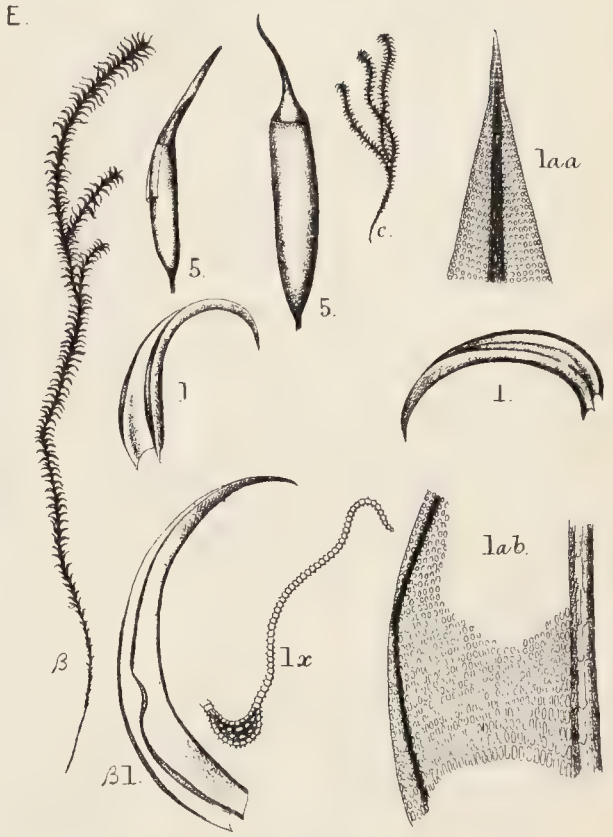
β. *Barbula vinealis* (from Braithw. l. c.) Description as for D.

C. *Barbula gracilis* (*acuta*) (from Braithw. l. c.). c. sterile plant × 1; 3, antheridial bud enlarged; others as above.

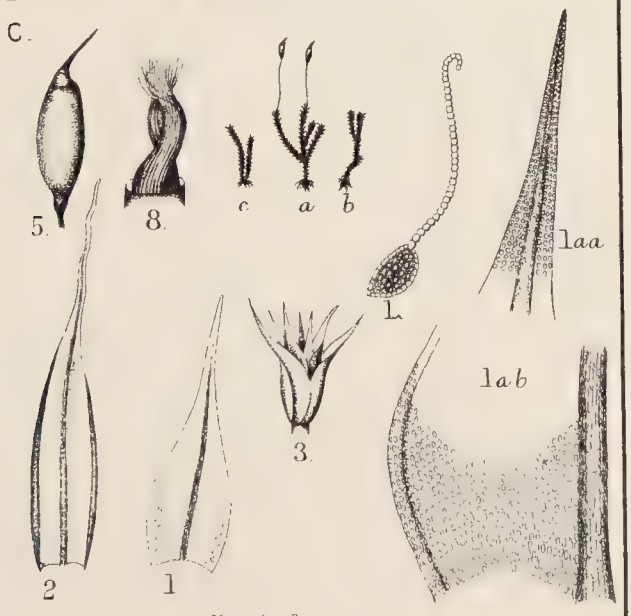
E. *Barbula reflexa* (from Braithw. l. c.). c, Sterile plant; 1–5, as above: β Var. *robusta* Braithw. × 1; β leaf of same magnified.

E′. *Barbula icmadophila* (from Braithw. l. c. **2**: *pl. 84*). Explanation of figures as above; c*, sterile plant enlarged. (Lower right.)

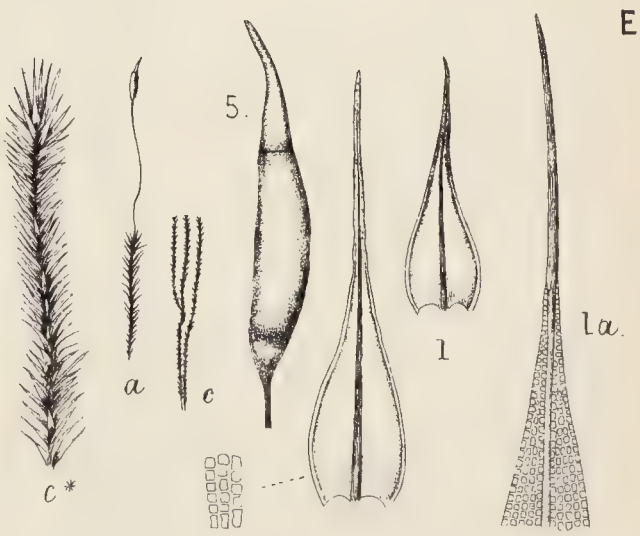




Barbula reflexa



Barbula acuta



Barbula icmadophila

PLATE LXXXVI.

PLATE 87. A. *Barbula eustegia* (from Bot. Gaz. **30:** *pl. 4*) 1a, plants × 1; b, same × 3; c, leaves × 32; d, cells of leaf base × 135; e, leaf apex × 135; f, outer perichaetial leaf × 32; g, inner perichaetial leaf × 32; h, capsule × 32; i, peristome × 60; j, portion of tooth × 285.

B. *Barbula brachyphylla* (from Pacific Railroad Reports **4:** 186. *pl. 2*). 4, Perichaetium with innovation; 5, upper leaves; 7, perichaetial leaf; 8, 9, base and apex of leaf showing cells; 10, cross section of the same; 11, capsule with calyptra and operculum; 12, shorter capsule; 13, peristome; 15, portion of peristome tooth greatly magnified; 16, annulus.

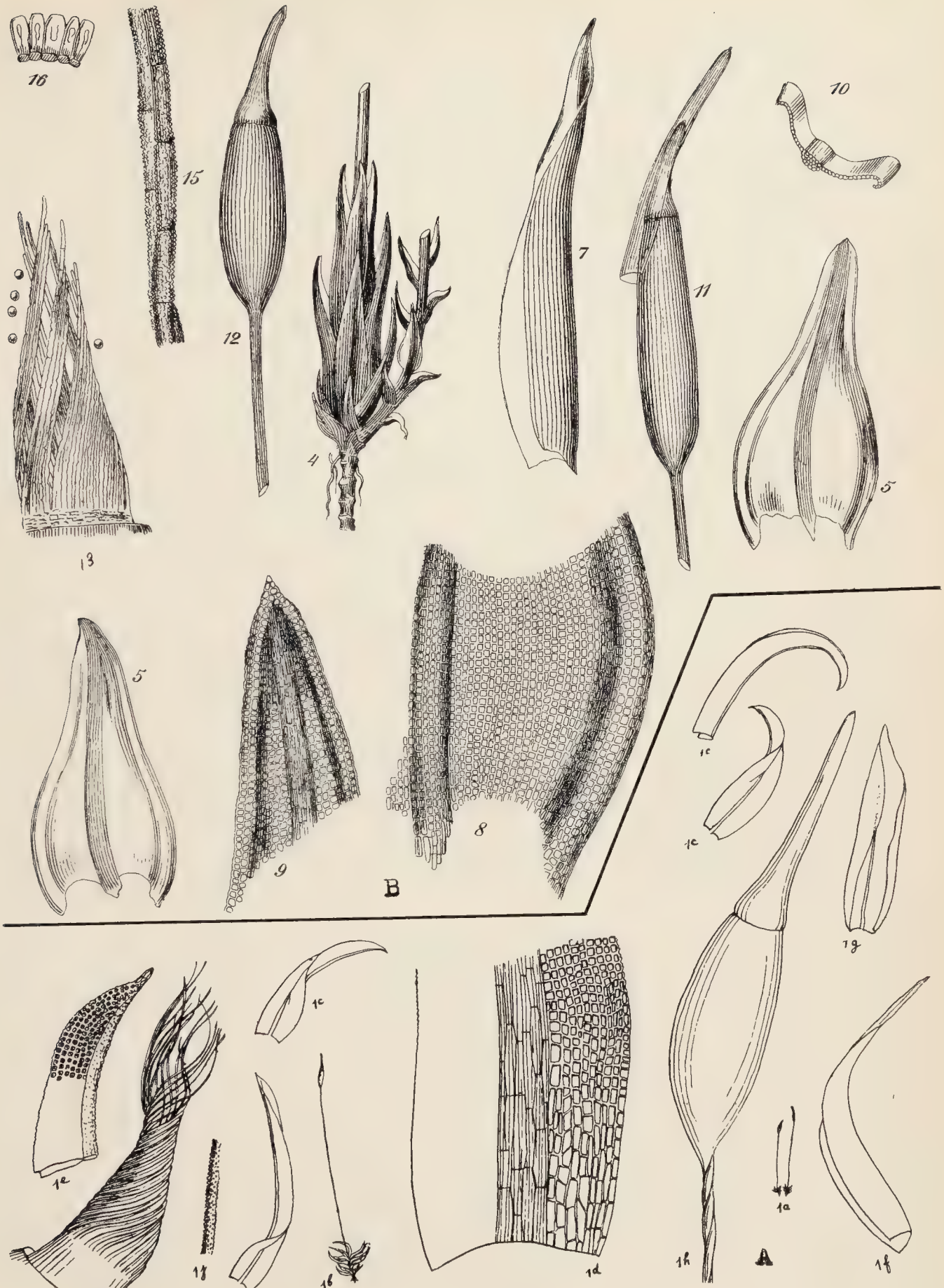


PLATE LXXXVII.

PLATE 88. *A. Barbula Bescherellei.* Whole sterile plant × 12; 2, 3, single leaves × 30; 4, cell detail from near leaf base × 333; 5, cell detail from near leaf apex × 333; 6, deoperculate capsule, showing peristome × 30.

B. Barbula platyneura. 1, 2, single leaves × 33; 3–6, series of cross sections of leaf, progressing from base to apex × 200; 7, cell detail from base of leaf × 333 (all from type material).

C. Barbula spiralis. 1, whole sterile plant × 12; 2, single leaf × 33; 3–5, cross sections of leaf, progressing from base to apex × 100; 6, cell detail from base of leaf × 333. (Figures A, B, C, by Dr. W. C. Steere.

D. Barbula Cruegeri. 1, sterile plant, showing axillary propagula × 7; 2, 3, leaves × 27; 4, detail of leaf apex × 333; 5, detail of areolation of leaf base × 333; 6, mature sporophyte, showing operculum and calyptra × 7; 7, deoperculate capsule, showing peristome × 7; 8, peristome, showing teeth cancellate below and appendiculate above × 33; 9, detail of peristome, showing cancellate teeth × 133; 10, 11, propagula × 200 (all from Renauld & Cardot, Musci Amer. Sept. Exsic. 23).

E. Barbula agraria. 1, entire fertile plant (section of seta removed) × 7; 2, 3, single leaves × 23; 4, detail of leaf apex × 200; 5, detail of areolation of leaf base × 200; 6, detail of dehiscence, showing revoluble annulus × 23; 7, portion of annulus × 67; 8, peristome, showing high basal membrane × 40 (all from Grout, N. Amer. Musci Perf. 75). (Figures (D and E) of this plate were drawn and the plate prepared for publication by Miss Olivia Embrey).

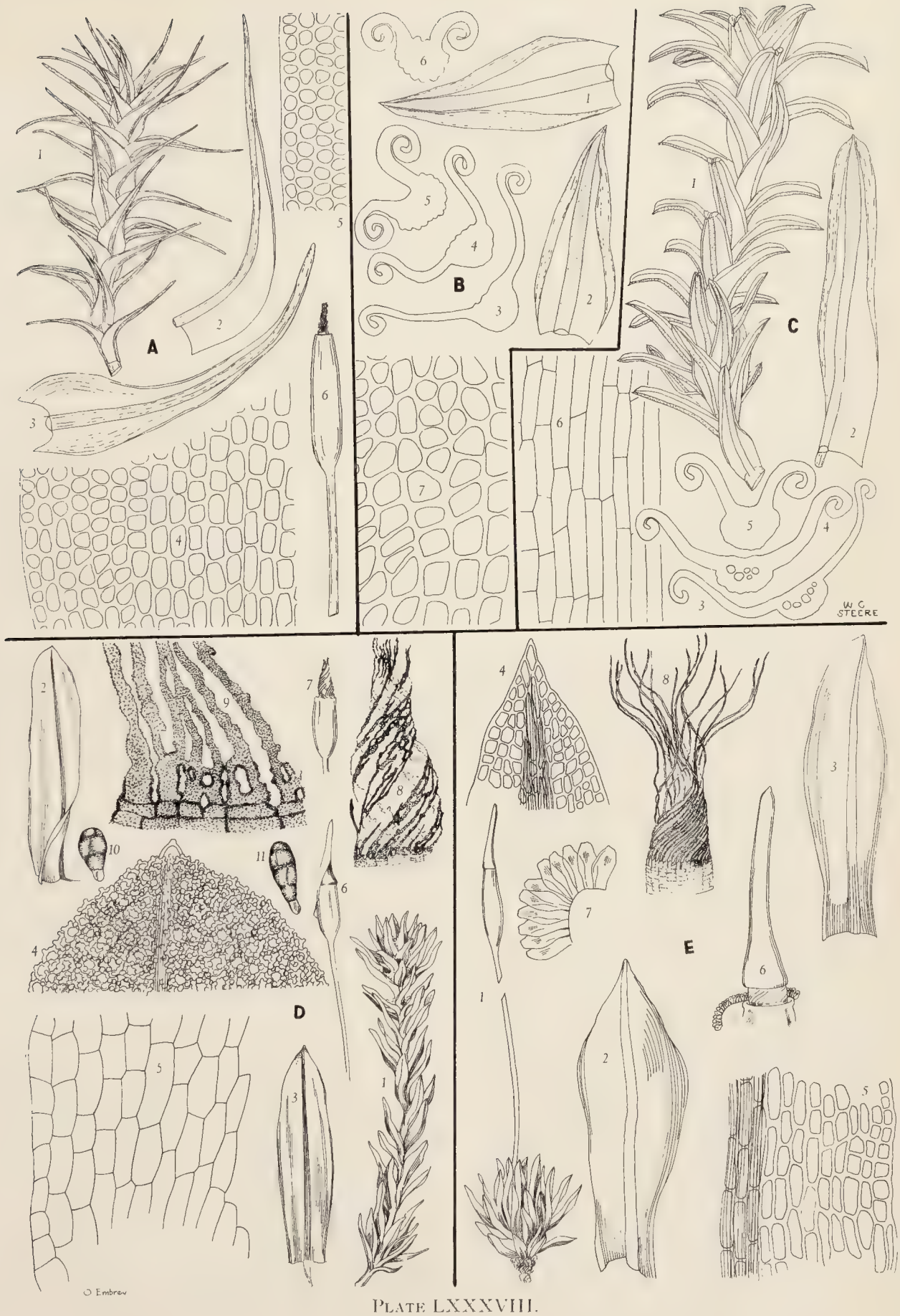


PLATE LXXXVIII.

PLATE 89. *A. Barbula michiganensis.* 1, whole sterile plant × 12; 2, 3, single leaves × 40; 4–7, propagula × 333; 8, cross section of costa × 333; 9, leaf cells from near apex × 333; 10, leaf cells from near base × 333 (from type material).

B. Barbula Ehrenbergii. 1, 2, single leaves × 26; 3, leaf cells from near base × 333; 4, leaf cells from near apex × 333

C. Didymodon mexicanus. Var. *subulatus.* 1, Moist plant × 1; 2, margin of lamina, ¼ way down × 600; 3, apex of leaf × 100; 4, cross-section of subula × 300; 5, cross-section from upper half of leaf (costa and one side) × 300; 7, base of leaf (one side) × 100; 8, 9, 10, and 11, leaves × 20.

C. Didymodon mexicanus. 1, Moist plant × 1; 2, margin of lamina, ¼ way down × 600; 3, apex of leaf × 100; 4, cross-section of subula × 300; 5, cross-section from upper half of leaf (costa and one side) × 300; 7, base of leaf (one side) × 100; 8, 9, 10, and 11, leaves × 20.

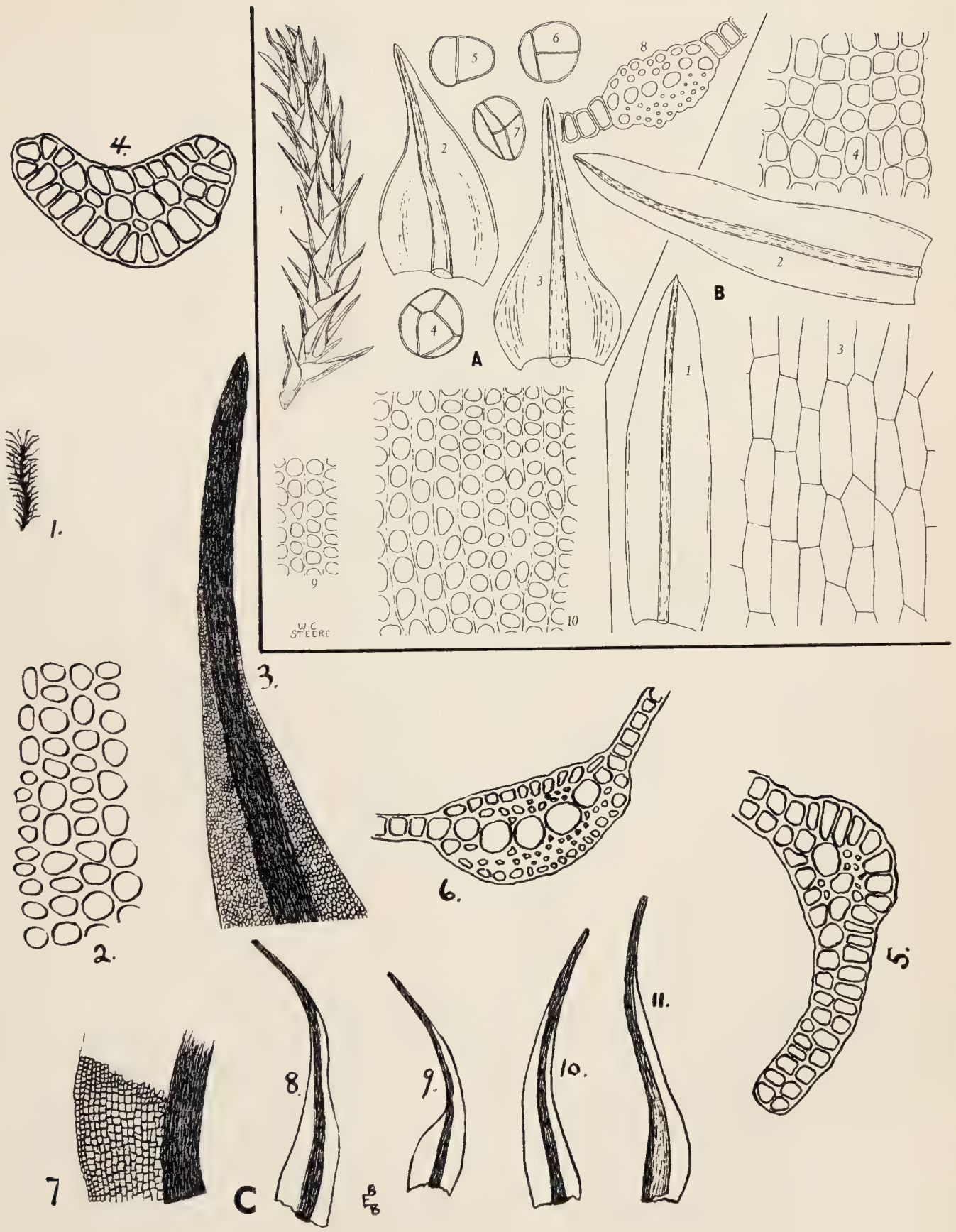


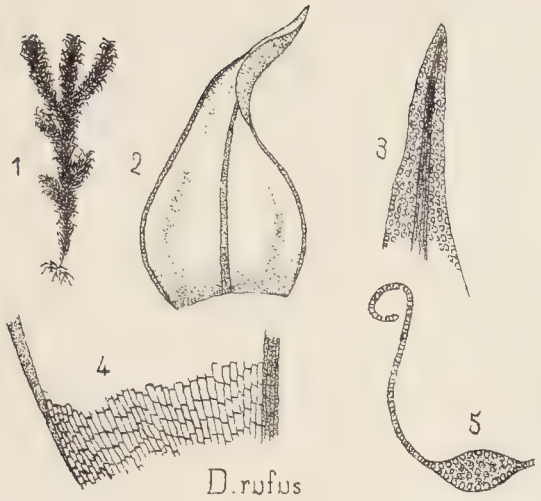
PLATE LXXXIX.

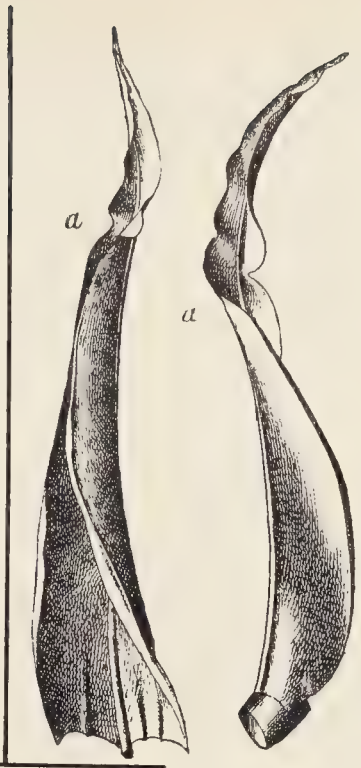
PLATE 90. *A. Didymodon giganteus* (from Limpr. Laubm. **1**: 568, *f. 162*). a, a, leaves × 24; b, two cross sections through the costa × 280; c, median leaf cells × 280.

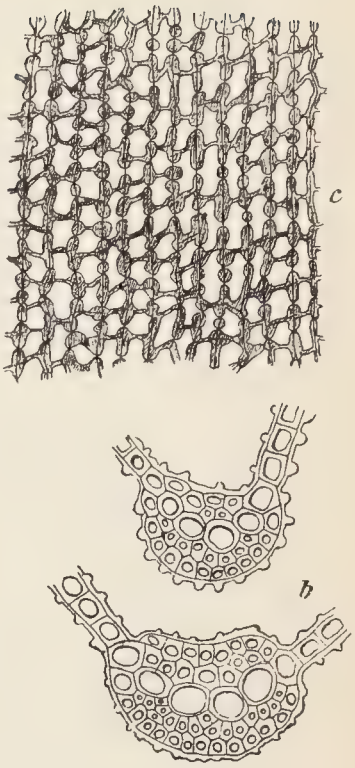
B. Didymodon rigidulus (*Barbula rigida*) (from Braithw. Brit. Moss Fl. **1**: *plate 40B*). a, archegonial plant × 1; b, antheridial plant × 1; 1, stem leaf much enlarged; 1x, cross section of same; 1aa, leaf apex more enlarged 1, ab, leaf base; 2, perichaetial leaf; 5, 5, capsules, operculate and deoperculate

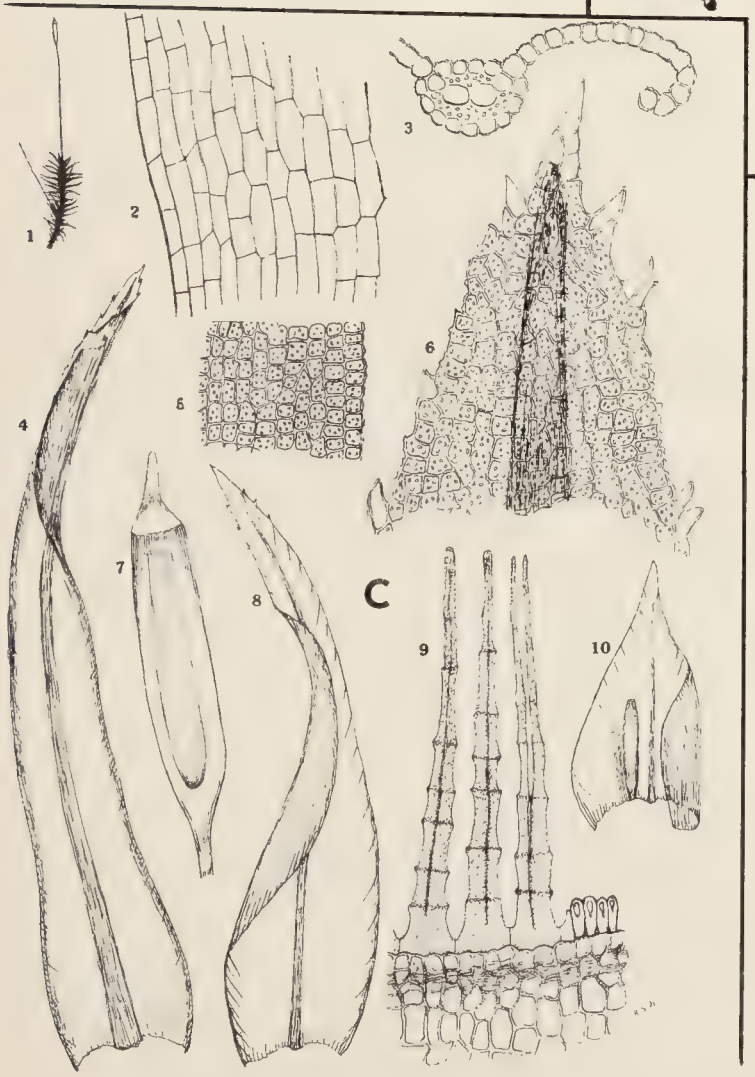
C. Didymodon recurvirostris var. *dentatus* (by R. S. Williams). 1, plant about × 1; 2, basal marginal leaf cells × 135; 3, median cross section of leaf × 135; 4, upper stem leaf × 23; 5, median leaf cells × 135; 6, apex of leaf × 135; 7, capsule × 17; 8, perichaetial leaf × 23; 9, annulus and part of peristome × 135; 10, perigonial leaf, paraphyses and antheridium × 23.

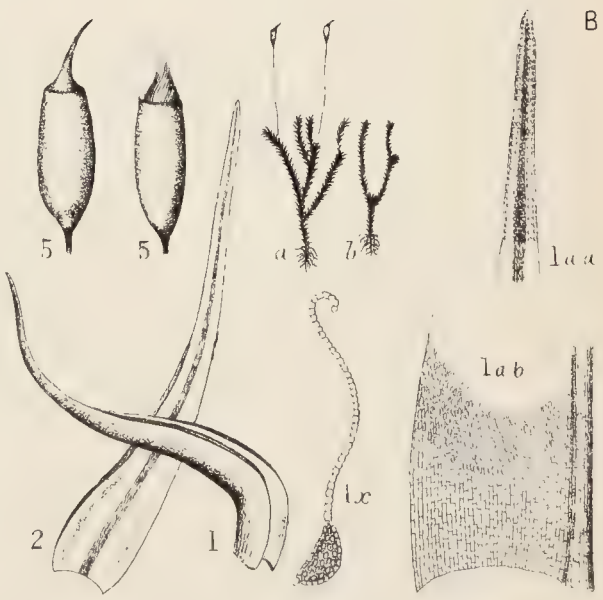
D. Didymodon rufus (from Husnot, Musc. Gall. *pl. 23*). 1, plant × 1; 2, leaf much enlarged; 3, leaf apex; 4, leaf base; 5, cross section of leaf.











Barbula rigidula

PLATE XC.

MOSS FLORA

OF

NORTH AMERICA

North of Mexico

BY

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ALOINA

BY MRS. ETHELDA J. CRAIG

TORTULA

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POTTIA AND PTERYGONEURUM

BY W. T. WAREHAM

Ohio State University

VOLUME I

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POTTIEAE.

Leaves mostly broad as compared to their length, ovate, lingulate, or spatulate; *costa with a single dorsal stereid band*, often excurrent into a hair point; basal cells usually rectangular, elongated, hyaline or translucent; upper cells smaller, rounded-quadrate to hexagonal; seta terminal, mostly elongated with capsule long-exserted.

In *Trichostomopsis* and *Husnotiella* the leaves are narrower and oblong to lanceolate but there is only a dorsal stereid band.

In *Acaulon* and *Phascum* the capsules are cleistocarpous and in most cases immersed.

KEY.

1.	Costa with ventral assimilation organs, filaments, sacs, or lamellae	2.
	Costa without such ventral organs	4.
2.	Costa with lamellae	*4. Pterigoneurum.*
	Costa with filaments	3.
3.	Stem without central strand; leaves with incurved margins rarely hair-pointed (except *A. rigida* var. *pilifera*)	*5. Aloina.*
	Stem with central strand, leaves hair-pointed; with margins plane or revolute.	*6. Crossidium.*
4.	Plants very small; capsules cleistocarpous, mostly immersed	5.
	Plants larger; capsules with well developed operculum and long-exserted (except *Pottia* species)	6.
5.	Capsules subglobose, not apiculate; leaves mostly smooth	*1. Acaulon.*
	Capsules subglobose to ovoid, mostly apiculate; leaves papillose or smooth	*2. Phascum.*
6.	Leaves not papillose but strongly mamillose both sides	*12. Bryobrittonia.*
	Leaves papillose to smooth or nearly so	7.
7.	Leaves bistratose above and on the margins	*9. Trichostomopsis.*
	Leaves not bistratose except sometimes on narrow margins	8.
8.	Leaves plainly bordered by cells elongated, or of a different color, shape or structure	13.
	Leaves not so bordered	9.
9.	Peristome lacking or of merely a low inconspicuous membrane	10.
	Peristome well developed	11.
10.	Costa thickened or spurred above; peristome of a narrow membrane	*7. Husnotiella.*
	Costa not thickened or spurred above; peristome lacking	*3. Pottia.*
11.	Peristome teeth from a narrow basal membrane, usually short and untwisted, never twisted more than 1 turn	12.
	Peristome teeth from a wide basal membrane, usually twisted more than one turn	*10. Tortula.*
12.	Peristome teeth short and undivided but often irregular or perforate	*3. Pottia.*
	Peristome teeth (with few exceptions) divided nearly to the base into two (rarely 3) slender filiform prongs, sometimes slightly twisted	*8. Desmatodon.*
13.	Leaves bordered below by a narrow band of elongate cells in 2–3 layers	14.
	Leaves bordered above by cells of different color or structure	15.
14.	Peristome absent	*Pottia Randii.*
	Peristome present	*Desmatodon cernuus and D. Laureri.*
15.	Peristome lacking	*11. Merceya.*
	Peristome well developed	*11.*

1. ACAULON C. Muell. Bot. Zeit. 5: 99. 1847.

Sphaerangium Schimp. Syn. 12. 1860.

Plants minute, bulbiform, gregarious; stem very short, without central strand, simple, from a persistent protonema; upper leaves larger, concave, convolute, often with spreading tips, upper margin plane and entire or revolute and sinuate-denticulate; costa excurrent into a short point, without guide cells; upper leaf cells short-rhombic, smooth or nearly so (except in *Schimperianum*), larger and looser below, the lowest thin-walled and rectangular. Dioicous; seta very short; capsule subglobose, almost or quite without apiculus, cleistocarpous, immersed; calyptra minute, irregularly torn at base. Type species, *A. muticum* ?

KEY.

1.	Leaves papillose both sides, ecostate below	*4. Schimperianum.*
	Leaves smooth or lightly papillose at back only, costate to the base	2.
2.	Plants subglobose, more or less three-cornered; seta longer than the vaginule; spores mostly under 30 μ, finely and sharply papillose	*3. triquetrum.*
	Plants ovoid-bulbose; seta shorter; spores over 30 μ, smooth or finely granulated	3.
3.	Basal leaf cells up to 100 μ long; spores finely granulated, 30–40 μ in diameter	*1. rubrum.*
	Basal leaf cells up to 90 μ; spores 40–50 μ, smooth	*2. rufescens*

1. ACAULON RUBRUM (Röhl.) **n. comb.**

Phascum rubrum Röhl. Ann. Wett. Ges. **1**: 187. 1809.
Phascum bulbosum Voit. Musc. Herb. 8. 1812.
Acaulon muticum (Schreb.) C. Müll. Bot. Zeit. **5**: 99. 1847.
Sphaerangium muticum Schimp. Syn. (Ed. 1) 13. 1860.

Plants gregarious, minute, when mature and fruiting reaching 2 mm. high including the leaves, oblong-ovoid in outline and slightly cuspidate by the tips of the entirely smooth leaves, the lower minute, the upper and perichaetial much larger, very concave, cymbiform, convolute, not keeled, enclosing the capsule, *revolute near the apex only*, irregularly sinuose-dentate near the broadly acute to blunt apex; costa distinct, percurrent, usually excurrent into a short mucro in the uppermost leaves; lower leaf cells hyaline, rectangular, up to 20 x 150 μ, longer and narrower towards the margin; upper median smaller rhomboid-hexagonal, 2–3 : 1. Seta straight, much shorter than the capsule, which is immersed, spherical or with a minute apiculus, about 0.5 mm. in diameter; calyptra minute; spores 30–40 μ, finely granulated, mature in winter to early spring. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 4;* Limpr. Laubm. **1**: 179. *f. 65;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 22C; Pl. 92.*

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 32, (Ed. 1) 25, at least in part; Aust. Musc. Appal. 51 ?

On bare soil, Illinois, Maryland (*J. D. Smith*), California (*Bolander*). Bolander's plants are very immature with smooth spores. Spore characters are very important in this genus, but it is evident that only mature spores are characteristic. This species is very rare in N. America.

2. ACAULON RUFESCENS Jaeg. Musci Cleist. 19. 1869.

Sphaerangium rufescens Jaeg. Adumb. **1**: 183. 1871–1872; Lesq. & James, Man. 40. 1884.

Described as intermediate between *A. rubrum* and *A. triquetrum*, but nearer the former. Plants subglobose, not three cornered; leaf margins sharply reflexed above and rather coarsely dentate in most plants; costa sometimes excurrent, more frequently percurrent or ending slightly below the apex; basal leaf cells usually shorter, 60 rarely 90 μ long; spores 40–50 μ, smooth. Type locality, eastern U. S.

ILLUSTRATIONS:—Roth, Aussereu. Laubm. **1**: *pl. 20, f. 8; Pl. 91 & 92.*

EXSICCATI:—Aust. Musc. Appal. 52 (as *Sphaeranguim muticum*); Grout, Musci Perf. 258. In Austin's 52 the spores are immature but smooth and mostly less than 40 μ in diameter.

Widespread east of the Rocky Mountains; Arizona (*Bartram*). It is probable that all our eastern plants referred to *rubrum* or *triquetrum* belong here.

A. rufescens should be regarded as a geographical subspecies of the European *rubrum*.

3. ACAULON TRIQUETRUM (Spruce) C. Muell. Bot. Zeit. **5**: 100. 1847.

Phascum triquetrum Spruce, Jour. Bot. **1845**: 189. 1845.
Sphaerangium triquetrum Schimp. Syn. (Ed. 1) 14. 1860.

Plants bulbiform, subglobose, about 1 mm. high, distinctly triquetrous; lower leaves minute; the inner and perichaetial broadly ovate, carinate, deeply concave, with the upper margins more or less reflexed, less denticulate than in the two preceding; costa also more strongly excurrent into a more or less recurved apiculus; basal leaf cells up to 60 μ long by 20 μ wide, 2–4 : 1, rectangular for the most part; the upper rhomboidal to hexagonal, often as broad as long, all narrower toward the margin; seta curved, nearly as long as the capsule; spores mostly under 30 μ, rough with minute sharp spines, mature in early spring. Type locality European, near Strassburg.

ILLUSTRATIONS:—Bry. Eur. *pl. 4;* M. H. M. *f. 67;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 22D.*
EXSICCATI:—Drumm. Musc. Am. 8, as *A. muticum;* Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 25.
On clayey or sandy unoccupied soil; western Canada to New England, south to S. Carolina. Rare or overlooked. The triquetrous form is often obliterated in the dry plants. The smaller, finely and sharply roughened spores seem the easiest distinguishing character in fully matured plants.

4. ACAULON SCHIMPERIANUM Sull. Mosses U. S. 15. 1856; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 26.

Plants minute, bulbiform, including the leaves 1–1.5 mm. high, copiously radiculose at base; lower leaves minute, the upper and perichaetial larger, 1–1.5 mm. long including the excurrent costa, broadly ovate, strongly concave and convolute, recurved at the apex, coarsely and irregularly toothed above with the teeth often double pointed, strongly papillose on both sides except near the base; the excurrent costa usually not extending below the middle, but in some plants (Holz. Musc. Acro. Bor. Am. 601) very strong and extending nearly to the base in some of the upper leaves; leaf cells thin-walled, the upper 25–30 μ wide, 1.7–3 : 1, the lower more elongated and rectangular. Male plants smaller, mixed with the female, bearing 3–4 leaves, 2–3 antheridia and no paraphyses; seta short, about ½ the diameter of the capsule, curved; capsule globose, apiculus scarcely perceptible; calyptra minute; spores very finely papillose, appearing nearly smooth, 30 μ or more in diameter, mature in winter. Type locality, San Marcos, Texas (*Wright*).

ILLUSTRATIONS:—Sull. Icones Musc. *pl. 9; Pl. 92.*
EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 26 (the type collection), (Ed. 2) 33; Holz. l. c. 601; Bartram, Mosses S. Arizona 115.
Although Holzinger's 601 from Arizona (*Bartram*) has the upper leaves with a much stronger costa than is found in the type, it is evidently the same species.

2. PHASCUM [L.] Hedw. Sp. Musc. 19. 1801.

Plants small, gregarious; stems 1–2 mm. high, without central strand, simple or divided; leaves ovate to broadly lanceolate, mostly entire with revolute margins; costa strongly excurrent, in cross section showing guide cells and a single dorsal stereid band; upper leaf cells quadrate to hexagonal, warty papillose on both sides (except *P. hyalinotrichum*), basal leaf cells larger, hyaline and more generally rectangular, less strongly papillose. Autoicous or synoicous; seta very short, sometimes curved; capsule usually immersed, sometimes slightly emergent, subglobose to ovoid, *apiculate*, operculum not differentiated; calyptra cucullate, rarely mitrate.

The original *Phascum* of Linnaeus and later as modified by Hedwig was so composite and ill defined that it is difficult to say what species should be assigned to it, or what its type species is according to any strict rules of nomenclature. *Pleuridium subulatum* is the first species mentioned in Hedw. Sp. Muscorum. *P. curvicollum* is the first species he mentions there that is now included in the genus. *P. cuspidatum* is the best known and most widely distributed species and should probably be considered the type.
The specimen of *P. subexsertum* described by Hooker in Drummond's Musc. Am. no. 9. 1828, can not be found. The plant described by Schwaegrichen, Suppl. **4**: *pl. 302b.* 1842 is *P. bryoides* Dicks (now transferred to *Pottia*) according to Cardot, Bull. L'Herb. Boiss. **7**: 363. 1899.
The American plant referred to *P. carnicolum* Web. & Mohr, in the Lesq. & James Manual p. 42 is not that species but an *Aschisma, A. kansanum* Andrews, Torreya **15**:63. 1915. (See p. 151 of this volume.)
Hall's specimens of *Pottia subsessilis* from the Field Museum of Natural History show no plants of *Phascum Floerkeanum* Web. & Mohr and none can be found at Harvard, the U. S. National Museum or the

New York Botanical Garden. It is probably safe to say that the species has not yet been found in North America.

Bush says (Bryol. **19**: 73) of the plants referred to this species by Cardot, Coll. Demetrio, "seems to me to be only another collection of *Phascum cuspidatum americanum*."

KEY.

Leaf cells strongly papillose ..... *1. cuspidatum.*
Leaf cells smooth ..... *2. hyalinotrichum.*

1. PHASCUM CUSPIDATUM [Schreb.] Hedw. Sp. Musc. 22. 1801.

Phascum acaulon L. Sp. Pl. 1570. 1753.
Phascum polycarpum Bry. Eur. fasc. 1. *pl. 6.* 1937 (the first printing).

Plants densely tufted, 1–2 mm. high, occasionally more, often branched; upper leaves largest, ovate to oblong-lanceolate, acuminate, carinate, entire, with margins more or less revolute in the middle, somewhat twisted when dry, up to 2 mm. or more long; costa smooth, excurrent; leaf cells rectangular and hyaline below, less papillose, above hexagonal, rhomboidal to shortly rectangular, 15–30 μ in greatest dimension, finely papillose at back. Capsules about 1 mm. long on short straight or curved setae of varying length, sometimes 2–3 together, ovoid-globose, immersed or slightly emergent, obtusely apiculate, cleistocarpous; calyptra cucullate, not reaching the capsule middle; spores 24–35 μ, mature in spring; antheridia clustered in the axils of the upper leaves. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 5;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 22E;* Limpr. Laubm. **1**: *figs. 68–70;* M. H. M. *f. 68.*

EXSICCATI:—Drumm. Musc. Am. 5. This and specimens collected by Prof. F. L. Pickett near Pullman, Washington seem to match the European plants very closely. The other American plants studied seem to belong to

1a. Var. AMERICANUM Ren. & Card. Bot. Gaz. **30**: 12. 1900.

Var. *piliferum* of American authors.

Costa long excurrent, often decolored at apex, nearest to var. *piliferum* (Schreb.) Hook. but leaves shorter, 2 mm. or less; seta shorter, erect. The leaves of American plants are usually much broader than figured in the Bry. Eur. and the awn in some cases is nearly the length of the leaf blades; leaves more strongly papillose especially along the margins. *Pl. 91C.*

On the same page Cardot & Thériot state that *Microbryum Floerkeanum* var. *Henrici* Ren. & Card. (Bot. Gaz. **14**: 91. 1899) is only a stunted form of this variety.

EXSICCATI:—Drumm. Musc. Am. 6, as var. *elatum;* Grout, Musci Perf. 299; R. & C. Musc. Am. Sept. 267.

On soil of banks and old fields; rare or at least infrequently collected; widely distributed in southern Canada and in the U. S.; south to Virginia, Oklahoma and Arizona.

The length of the excurrent costa and the width of the leaves is extremely variable and the var. *piliferum* seems of little consequence. Var. *americanum* seems a pretty well marked geographical variant.

The spores also vary a great deal in size and roughness.

The lower leaves and leaves of immature plants strongly resemble those of *P. Floerkeanum* but can be distinguished by the larger leaf cells.

Cheney has collected along the banks of the upper Mississippi "a small brown form" which seems to be much like that mentioned by Dixon, l. c. page 177 as "usually growing on clay." Drummond's no. 6 seems to be the same thing.

2. PHASCUM HYALINOTRICHUM Card. & Thér. Bot. Gaz. **37**: 363. *pl. 16.* 1904.

Plants very small, solitary or gregarious, pale green; leaves imbricate, the lower short, the upper larger reaching 2 mm. with awn, median and upper ovate, 0.8–1 mm. long by 0.6 mm. broad, concave, acuminate, entire or subentire; margins plane or slightly reflexed below; costa narrow, 24 μ wide in the middle of the leaf, attenuate below, excurrent into a piliferous point ½–⅓ the length of the leaf, flexuous and hyaline; areolation lax, *entirely smooth,* slightly chlorophyllose, hyaline above; median leaf cells irregular, quadrate, shortly rectangular or subhexagonal, 18–30 x 12–18 μ, thick-walled, the lower larger and thinner-walled, the upper longer and incrassate. Capsule on a very short (0.2 mm.) geniculate seta; capsule immersed,

globose apiculate, 0.7 mm. in diameter; calyptra cucullate, covering the upper ½ of the capsule; mature spores unknown. Type locality, Soldier's Home, Los Angeles Co., California (Dr. Hasse, 1902, in Herb. C. F. Baker). *Pl. 92.*

"A quite peculiar species, very distinct by its habit, which recalls that of an *Acaulon*, its puliform excurrent nerve and its loose smooth areolation, a little chlorophyllose below and hyaline above." Type duplicate seen.

3. POTTIA [Ehrhart] Fürnrohr in Flora **12**[2]: 10. 1829.

By R. T. Wareham*

Anacalypta Röhl. Moosg. 109. 1800.
Mildeella Limpr. Laubm. **1**: 191. 1890.
Stegonia Vent. Rev. Bryol. **10**: 96. 1883.

Plants small to medium sized, cespitose to sod-forming, usually growing on soil but occasionally on earth-covered rocks; stems simple or branched, with a central strand (except *P. Randii*, *P. texana*, *P. bryoides* and *P. Fosbergii*), bearing rhizoids only at the base; leaves tufted, erect, spreading, or closely imbricated (resulting in a bulbiform plant), broadly ovate to lanceolate or lingulate to spatulate, usually papillose in upper and smooth in lower half, concave, often keeled; margins entire to toothed, plane to recurved, sometimes slightly incurved in *P. nevadensis;* cells in upper half quadrate to hexagonal, thin- to thick-walled, occasionally slightly collenchymatous; below elongated, thin-walled and hyaline; costa subpercurrent to long excurrent, usually quite strong, biconvex, frequently papillose on both sides, in cross section with dorsal stereid band only; perichaetial leaves usually scarcely different from the others. Paroicous, synoicous or polyoicous; antheridia and archegonia borne naked or with thread-like to almost clavate paraphyses; seta with a central strand, elongated, straight to flexuose, usually twisted when dry; capsule long-exserted in all our species (except some forms of *P. bryoides*), yellowish to reddish-brown, obovate to ovate to long-cylindric, with a rounded base to distinctly short-necked, symmetric to somewhat arcuate, narrow- to wide-mouthed when deoperculate, bearing phaneropore stomata on the rounded base or on the neck; annulus sometimes not differentiated, when present persistent to detachable (persistent when present in all our species); calyptra cucullate, smooth to very scabrous; spores papillose to tuberculate, 8–50 μ in diameter (18–50 μ in our species). Type species *P. truncata.*

Brotherus in Engler & Prantl, Pflanzenfam. **10**: 289. 1924 classified 51 species of the genus into four sub-genera. These, along with *Stegonia* Vent., are here treated as sections of the genus *Pottia.*

I. *Schizophascum.* Capsule always exserted, short-necked, beaked, bursting at maturity.

2 Australian species. *P. Fosbergii* probably belongs here.

II. *Pottiella.* Seta as long or a little longer than the capsule. Capsule without neck, with operculum small, short-pointed to obliquely beaked, persistent.

2 species. Neither one known in North America.

III. *Mildeella.* Seta shorter or longer than the perichaetial leaves, erect. Capsule short-necked, with persistent, oblique, cone-shaped operculum and peristome consisting of 16, two-layered, thread-like, papillose, yellow teeth.

1 species. *P. bryoides.*

IV. *Eupottia.* Capsule always exserted, operculum deciduous, leaves erect to spreading.

49 species. *P. Randii, lanceolata, truncata, nevadensis, Heimii, Starkeana, texana,* and *arizonica* occur in North America.

V. *Stegonia.* Leaves closely imbricated and very concave resulting in a bulbiform plant, weakly chlorophyllose, smooth.

2 species. *P. Mouretii* from Morocco and *P. latifolia.*

The following species of *Pottia* recorded from North America, north of Mexico are excluded from the list: *P. intermedia* (Turn.) Fürnr. (See p. 201), *P. litoralis* Mitt. (See p. 201), *P. mutica* Vent. (See p. 202), *P. Davalii* (Sm.) comb. nov. = *P. minutula* (Schleich.) Bryol. Eur. = *P. rufescens* (Schultz) Warnst. (See p. 201), (*P. Wilsoni* (Hook.) Bry. Eur. (See p. 203).

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* Paper from the Department of Botany, the Ohio State University, No. 414. The author thanks the persons and institutions who have given assistance in this study.

Key to Species.

1. Leaves smooth to very sparsely papillose in upper half		2.
Leaves densely papillose in upper half		8.
2. Plants bulbiform; capsule peristomate		3.
Plants not bulbiform, leaves erect or spreading; capsules gymnostomous or peristomate		4.
3. Leaves blunt to short apiculate	*11.*	*latifolia.*
Leaves long-awned by the excurrent costa	*11a.*	var. *pilifera.*
4. Capsules arcuate; leaf margins 2–3 cells thick below the middle	*7.*	*Randii.*
Capsules symmetric; leaf margins not thickened		5.
5. Leaves entire to serrulate by projecting transverse walls near apex, margins plane to recurved at the middle		6.
Leaves (some on every plant) coarsely toothed near apex		7.
6. Peristome present; leaf margins mostly recurved	*8.*	*lanceolata.*
Peristome lacking; leaf margins mostly plane	*3.*	*truncata.*
7. Costa excurrent into a smooth awn in most leaves	*9.*	*nevadensis.*
Costa subpercurrent to forming a strong, short mucro	*10.*	*Heimii.*
8. Capsules cleistocarpous		9.
Lid separating from the urn when mature		10.
9. Lid distinguished from urn by a band of quadrate cells; peristomate	*2.*	*bryoides.*
Lid not distinguished by a band of quadrate cells; peristome lacking	*1.*	*Fosbergii.*
10. Leaves usually bordered by 2–6 rows of less papillose, yellowish cells; margins plane, usually coarsely toothed above; lid systylous		11.
Leaves not bordered; margins recurved; lid not systylous		12.
11. Leaves acute to acuminate, usually coarsely toothed above	*10.*	*Heimii.*
Leaves obtuse, usually entire to serrulate	*10a.*	var. *obtusifolia.*
12. Leaves serrulate by projecting transverse walls; calyptra smooth; seta twisted to right below and to left above	*8.*	*lanceolata.*
Leaves entire except for papillae; calyptra papillose; setat wisted to right or left		13.
13. Spores regularly tuberculate, not papillose; seta ordinarily 2–3 mm. long	*5.*	*Starkeana.*
Spores irregularly tuberculate or non-tuberculate, mostly papillose		14.
14. Spores densely and coarsely papillose, brown, almost opaque; capsule gymnostomous; upper leaf cells mostly 12–15 μ wide, quadrate	*4.*	*texana.*
Spores irregularly tuberculate to non-tuberculate, mostly minutely papillose and yellow-transparent, upper leaf cells mostly 9–12 μ wide, hexagonal		15.
15. Costa short-excurrent to forming an awn up to 0.26 mm. long; peristome well-developed	*6.*	*arizonica.*
Costa subpercurrent to short-excurrent; peristome lacking or consisting of a basal membrane only	*6a.*	var. *mucronulata.*

1. Pottia Fosbergii Bartram, Bryol. **33**: 18. *pl. 2.* 1930.

Plants small, gregarious; stems without central strand, up to 1 mm. long, often branched at base; leaves erect to somewhat spreading, broadly ovate to oblong, *acute* to *short-acuminate* to *minutely apiculate*, *concave;* the upper ones 0.8–1.3 mm. long, much shorter below; leaf cells in upper part 13–17 μ wide, quadrate to hexagonal, chlorophyllose, densely papillose, with medium thick walls, not collenchymatous; progressively longer and wider and less papillose toward the base; basal cells hyaline, thin-walled, 18–30 μ wide, mostly rectangular, up to 3–1; margins recurved from the base to or near the apex, entire below, usually slightly serrulate above; *costa yellowish*, percurrent or subpercurrent, area of thick-walled cells in cross section up to 35 μ wide. Paroicous; antheridia about 0.16 mm. long, with thread-like paraphyses, in the axils of the upper leaves; archegonia terminal with a few paraphyses; sporophyte single; seta with small central strand, flexuose or slightly curved, 2–3 mm. long, yellow; capsule brown, *cleistocarpous*, 0.9–1.5 mm. long, 0.35–0.44 mm. wide, oval-elliptic, often slightly unsymmetric, with a *short, conic, somewhat oblique, persistent beak, not distinguished from the urn by quadrate cells;* neck scarcely distinct; stomata on the capsule

base; exothecial cells thin-walled, 15–20 μ wide, quadrate to short-rectangular in small forms, typically quite regularly 4–1, square or pointed at the ends, shorter toward the base and apex; *peristome lacking;* calyptra cucullate, *smooth;* spores light brown, finely papillose, 23–30 μ in diameter; mature in spring. Type locality East side Indian Hill, Claremont, Los Angeles Co., California.—*F. R. Fosberg.*

ILLUSTRATIONS:—Bryol. **33:** 19. *pl. 2.* 1930; *Pl. 95* and *103.*

EXSICCATI:—Pomona Col. Herb., Mosses of So. Calif. D24a, in Herb. of E. B. Bartram, Bushkill, Penn. (The TYPE); Templeton Crocker Exped. Calif. Acad. Sci., Flora of Lower Calif.; New York Bot. Gard., Herb. Marshall A. Howe, Feb. 1895, as *P. Starkeana,* in part; Farlow Crypt. Herb., Herb. Clara E. Cummings, Coll. O. D. Allen, Feb. 20, 1885, as *P. Starkeana,* in part; U. S. Nat. Herb., Crypt. Coll. John Leiberg, as *P. Starkeana,* in part.

On soil. Four collections from Southern California and one from Lower California. Three of these collections were labeled and contained some *P. Starkeana.* Smaller than *P. bryoides* with a relatively longer seta; further distinguished from it by the absence of quadrate cells between the lid and the urn and absence of a peristome. Distinguished from *P. recta* by the longer seta and capsule, the percurrent costa, smooth calyptra and minutely papillose spores. The lack of differentiation between lid and urn and the absence of a central strand are characteristic of the genus *Phascum,* however the long-exserted, long-elliptical capsule, and the percurrent costa are characteristic of some *Pottias.* It is possible that it should be treated in *Phascum.* Certainly it belongs somewhere between typical *Phascum* and typical *Pottia.*

2. POTTIA BRYOIDES (Dicks.) Mitt. Ann. and Mag. Nat. Hist. (Ser. 2) **8:** 311. 1851.

Phascum bryoides Dicks. Plant. Crypt. Brit. fasc. **4:** 3, *pl. 10, fig. 3.* 1801.
P. gymnostomoides Brid. Spec. Musc. **1:** 7. 1806; and Bryol. Univ. **1:** 48. 1826.
P. elongatum Schultz, Fl. Starg. 273. 1806.
P. graniferum Wahl. Vet. Acad. Nya Handl. **27:** 131, *pl. 4, fig. 3.* 1806.
P. pusillum Schleich. Cat. 1815.
P. subexsertum Schwägr. Suppl. **4:** *pl. 302b.* 1842.
Tortula bryoides Lindb. Musc. Scand. 21. 1879.
Mildeella bryoides (Dicks.) Limpr. Laubm. **1:** 192. 1890.

Plants including sporophytes from 2–10 mm. high, usually about 5–7 mm., sod-forming; stems simple or occasionally branched, without central strand; leaves imbricated, erect, concave, keeled, ovate to broadly lanceolate to lanceolate, acuminate, narrowed to the insertion, twisted when dry; costa yellowish, strong, excurrent, forming a *smooth, yellowish-brown* awn; upper leaves up to 3.2 mm. long by about 1 mm. wide, progressively smaller toward the base of stem; perichaetial leaves not differentiated; margins narrowly recurved from the base to very near the apex in most leaves, entire below, faintly serrulate near apex in most specimens; some specimens papillose along the upper part or the whole margin; median cells irregularly oblong to quadrate, 15–21 μ wide, usually a little longer than wide, papillose on both sides, sometimes almost smooth, fairly thick-walled, sometimes almost collenchymatous; basal cells about twice as large, oblong, smooth, thin-walled, hyaline, the lower two or three rows smaller, usually brown. Autoicous; antheridia usually naked, at the ends of short basal branches bearing several minute, costate leaves; capsules emergent to long exserted; seta with central strand, light brown to reddish, straight to slightly curved, usually twisted to the left when dry, 1.0–4.5 mm. long, usually 2–3 mm.; urn 0.5–0.8 mm. x 0.7–1.7 mm., erect to slightly inclined, *usually slightly unsymmetrical, short necked,* with stomata on the neck; exothecial cells thin-walled, irregularly oblong, about 20 μ wide at middle of urn; lid *persistent, differentiated* by 2–4 rows of smaller, rounded cells, long-conic to short-rostrate, oblique; cells of the lid elongated, *usually steeply spiraled to the left;* peristome more or less *rudimentary to quite well-developed,* when complete consisting of 16 *narrow, pale, papillose* teeth on a short basal membrane, the whole structure more or less fused with the inner layers of the lid, difficult to find except in mature specimens and then usually only by splitting the lid; calyptra cucullate, smooth to slightly papillose, covering about one-half the urn; spores papillose, 22–38 μ in diameter; mature in spring. Type locality, Europe.

ILLUSTRATIONS:—Limpr. Laubm. l. c. 191 and 193, *figs. 72–75;* Schwägr. Suppl. **1:** *pl. 1* and **4:** *pl. 302b,* top; Braith. Brit. Moss Flora **1:** *pl. 28C;* Bryol. Eur. *pl. 6* (drawings very inaccurate); Dixon Handb. Brit. Mosses (Ed. 3), *pl. 22 I.* 1924; *Pl. 94.*

EXSICCATI:—Drumm. Musci Am. 9; Bartram. Mosses of Pima Co., Ariz. 1618, 151; Holz., Musci Acro. Bor. Am. 328; Herb. M. A. Howe 155.

On soil. Known in North America only from Arizona, California, and Saskatchewan.

3. Pottia truncata (Hedw.) Fürnrohr, Flora **12**[2]: 10. 1829.

Gymnostomum truncatum Hedw. Spec. Musc. 30. 1801.
Gymnostomum truncatum β *minus* Web. & Mohr, Taschenb. 81. 1807.
Gymnostomum circumcissum Röhl. Ann. Wett. Ges. **2**[1]: 122. 1810.
Pottia truncata Bruch, in Herb.; Fürnr. Flora **12**[2]: 10. 1829.
Pottia eustoma var. β *truncata* Hampe, Flora **20**[1]: 287. 1837.
Pottia eustoma (Ehrh.) C. Müll. Synop. Musc. **1**: 553. 1849.
Pottia truncatula Lindb. De Tort. 220. 1864.
Tortula truncatula Lindb. Musc. Scand. 21. 1879.

Gregarious to sod-forming; gametophyte up to 1 cm., usually 3–5 mm. high; stems with small central strand in upper portion, branched or simple; upper leaves *lanceolate to broadly lanceolate to spatulate, slenderly acuminate to acute*, widest at or above the middle, not abruptly narrowed to the insertion, *smooth to very slightly papillose on the lower side* in the upper half, 1–2.5 mm. long, shorter toward the base of the stem; costa strong, yellowish to reddish-brown, *typically excurrent into a smooth, stout, yellowish to brown awn*, rarely ending below the apex, in which case there is an apiculus of thin-walled cells; median cells chlorophyllose, 15–22 μ wide, with medium-thick walls, sometimes slightly collenchymatous (toward the margin commonly thicker-walled and slightly smaller), very irregular in shape—oblong to quadrate to hexagonal—somewhat smaller and rhomboidal toward the apex, progressively larger, thinner-walled and hyaline toward the base; at the base all hyaline, rectangular, up to 4–1; margins *plane or narrowly recurved to above the middle* (both conditions may occur on the same plant), entire below, *entire or more commonly serrulate to papillose by projecting transverse walls near the apex*, sometimes sparsely papillose with true papillae near the apex, rarely one or more cells projecting as teeth near the apex. Autoicous; antheridia up to 0.17 mm. long, occurring in a group with a few longer, hyaline, clavate paraphyses or naked in the axils of 1–2 minute, ecostate, ovate, acute leaves, located along the stem from near the base to near the stem tip; archegonia terminal, with no paraphyses; *sporophytes single or two or more from the same stem tip;* urn *gymnostomous*, erect, 0.4–0.79 x 0.4–1.1 mm., obovate before lid falls, *wide-mouthed and truncate afterward*, finely striate when dry; *neck short, rather indistinct;* stomata on the neck; lid erect or obliquely long-rostrate from a low-arched base; exothecial cells 23–40 μ wide, irregularly quadrate to oblong, 1 : 1 to 1 : 3, thick-walled,; mouth bordered by 2–4 rows of smaller, rounded cells; annulus of 1–2 layers of small, very thick-walled, light-colored cells, persistent; *club-shaped, hyaline, 15–20 μ long, pectic filaments extending from each cell of the annulus when the operculum falls.* (Can be readily seen only when the operculum is carefully removed from the mature capsule under water); calyptra smooth, cucullate, covering about one-half the urn; seta with central strand, reddish-yellow, twisted to the right, 2–6.5 mm. long; spores reddish-brown to brown, finely papillose, 23–30 μ in diameter; mature from late autumn to spring. Type locality, Europe.

Illustrations:—Bryol. Eur. *pl. 120;* Dixon, Handb. Brit. Mosses (Ed. 3), *pl. 22 K;* Jenn. Mosses of Western Penn. *pl. 13;* Braith. Brit. Moss. Fl. **1**: *pl. 28 E;* Grout M. H. M. *pl. 33; Pl. 95.*

Exsiccati:—Austin, Musci. Appal. 111; Sull. & Lesq. Musci Bor. Amer. (Ed. 1) 90 and (Ed. 2) 116; Macoun, Can. Musci 154; part of Macoun, Can. Musci 62; E. G. Britton, N. Amer. Mosses 19, 99; G. N. Best, N. Amer. Mosses 52; E. B. Bartram, Flora of Penn. 941, 990, 991; Grout, Musci Perf. 216, 277; Holz. Musci Acro. Bor. Am. et Eur. 545.

On various substrates, from alluvial soil to old stone walls, where there is a plentiful supply of moisture. Frequently found on flood plains and wet meadows. In Canada, from Nova Scotia to the shores of Lake Huron; lower Michigan, western Pennsylvania and throughout eastern United States south to Maryland. A specimen from Indiana labeled *P. truncata* is *Weisia viridula*. Two specimens labeled *P. truncata* are known from Wisconsin; one is *Gymnostomum recurvirostrum*, one *Physcomitrium* sp. Specimens labeled *P. truncata* from Carson City, Nevada; Yale, British Columbia; Frazer River Valley, British Columbia; and Cascade Mountains, British Columbia are *P. nevadensis*. The first was collected by Sereno Watson and distributed under U. S. Geol. Ex. 40th Par. No. 1381; the rest were collected and distributed by Macoun. Macoun's Canadian Musci 62, collected on "Earth on limestone rocks, Gaspé Coast," labeled *P. truncata* Fürn., requires some explanation. In the *Catalogue of Canadian Plants*, Part VI, pages 42 and 43, 1892, Macoun and Kindberg list the following:

> (154.) **P. truncata**. . . . Canadian Musci, No. 62 in part. On earth in fields, James Terrill's farm near Wooler, Northumberland Co., Ont. (*Macoun.*)
> (155.) **P. intermedia**. . . . *P. truncata*, Canadian Musci, No. 62, in part. On earth on the Portage between Lesser Slave Lake and Peace River, September 23rd., 1872. (*Macoun.*)
> (156.) **P. litoralis** Mitt. . . . . *P. truncata*, Canadian Musci, No. 62, in part. On earth at Yale, B. C., May 17th, 1875. (*Macoun.*)

There is no reference to any Gaspé Coast specimen, yet all the material distributed under No. 62 bore this designation. The material consists of at least three species: *P. nevadensis*, *P. truncata*, and *Desmatodon obtusifolius* (Schwägr.) Jur. The last, in the Farlow Cryptogamic Herbarium, has been relabeled as follows: "*P. riparia* Aust., corrected by Kindberg." No. 62 is apparently of diverse derivation and identification, and excepting No. 62, *P. nevadensis* is entirely Western, while *P. truncata* is entirely Eastern. It therefore seems reasonable to disregard this portion of the exsiccati in discussing distribution.

The author has not seen authentic North American specimens which might be placed definitely in *P. intermedia* (Turn.) Fürn. or in *P. litoralis* Mitt. These two species are probably varieties, or at best, subspecies of *P. truncata* and have been treated as such by various authors.

4. Pottia texana Wareham **n. sp.**

Plantae caespitosae, caule 0.5–1.0 mm. longo, ramis nullis. Folia erecta, superioribus 0.8–1.5 mm. longis, lanceolatis, sive brevius sive longius acuminatis; inferioribus brevioribus ovatisque; perichaetialibus non dissimilibus. Cellulae laminae superiores dense papillosae, plerumque quadratae, plerumque 12–15 μ latae; inferiores leves oblongae, 15–25 μ latae, usque ad 3 : 1. Margines laterales recurvatae, integerrimae. Costa crassa, ad 0.1 mm. excurrens, flavo-fusca. Paroicae, antheridiis nudis in foliorum superiorum axillis. Capsula deoperculata 0.5–0.7 mm. longa, ovata, fusca, gymnostoma, annulo deficiente, operculo breviter oblique-rostrato. Seta flavo-fusca 2–3 mm. longa, dextrorsum torta. Calyptra cucullata, dense scabra. Sporae dense papillosae, 23–31 μ diam. Differunt plantae ab *P. minutula* praecipue sporis non aculeis instructis.

Plants cespitose; stems without central strand, 0.5–1.0 mm. long, not branched; leaves tufted, erect to slightly incurved at the tips; upper leaves 0.8–1.5 mm. long, *lanceolate*, short- to long-acuminate; shorter and ovate below. Median cells 6–15 μ wide, *usually 12–15 μ, mostly quadrate* to slightly longer than wide, *conspicuously arranged in rows parallel to the margin*, fairly thick-walled, densely mammilate-papillose; marginal and apical cells not different; toward the base less papillose, longer and wider; basal cells thin-walled, 15–25 μ wide, up to 3 : 1; margins narrowly recurved from the base to or near the apex, entire except for papillae in upper half; costa yellowish-brown, up to 50 μ wide, densely papillose above, sparsely so or smooth below, excurrent into a stout, brownish awn up to 0.1 mm. long. Paroicous; antheridia 40–50 μ long, short-stalked, naked in the axils of the upper leaves. Archegonia terminal, naked; sporophytes single or in pairs; urn 0.5 to 0.7 mm. long, ovate, light brown; *gymnostomous;* not wide-mouthed when deoperculate; neck not distinct; stomata on capsule base; exothecial cells at middle of capsule very irregularly quadrate to rectangular, 12–40 μ wide, up to 3 : 1, fairly thin-walled; mouth bordered by 2–3 rows of darker colored, much smaller, thick-walled, quadrate cells; annulus not differentiated; lid *short-rostrate from an arched base*, over all up to 0.35 mm. high; seta yellowish-brown, with small central strand, 2–3 mm. long, twisted to the right; calyptra cucullate, covering about three-fourths of the urn, scabrous with many blunt papillae; spores densely papillose, almost opaque when mature, 23–31 μ in diameter. Type locality, near St. Marcos, Texas.—*C. Wright.* Distributed by Sullivant and Lesquereux as *P. minutula* Bryol. Eur.

Illustrations:—Pl. *93*.

Exsiccati:—Sull. & Lesq. Musci Bor. Am. (Ed. 1) 91, (Ed. 2) 117, issued as *P. minutula* (the type).

By the appearance of the substrate, on sandy soil. No habitat data are given on the label. This species differs from *P. minutula** principally in having low-papillose rather than echinate spores. It is distinguished from *P. arizonica* by almost opaque spores, larger leaf cells, and lanceolate leaves. St. Marcos can not be located but it may be the San Marcos of present day maps, located some 50 miles north and east of San Antonio.

5. Pottia Starkeana (Hedw.) C. Müll. Synop. Musc. **1**: 547. 1849.

Weisia Starkeana Hedw. Spec. Musc. 65. 1801.
Bryum minutulum Dicks. Plant. Crypt. Brit. **4**: 3, *pl. 10, fig. 17*. 1801.
Anacalypta Starkeana Bruch in Herb.; Fürnr. Flora **12**^{2}: 35. 1829.
Dermatodon Starkii Hüben. Muscol. Germ. 109. 1833.
Desmatodon Starkii De Not. Syll. 205. 1838.
Tortula Starkei Lindb. Musc. Scand. 21. 1879.

Plants cespitose; stems with small central strand, usually unbranched, 1–2 mm., usually about 1 mm. long; leaves tufted; upper ones ovate to ovate-lanceolate, acute to short-acuminate, up to 1.5 mm. long;

* *P. minutula* (Schleich) Bry. Eur. = *P. rufescens* (Schultz) Warnst. = *P. Davalii* (Sm.) **n. comb.** = *Gymnostomum Davalianum* Sm., Kon. Sims Ann. Bot. **1**: 577. 1805. (According to Lindberg.)

shorter and ovate below; perichaetial leaves not differentiated; median cells usually thin-walled, irregularly quadrate to hexagonal, 7–11 μ wide, densely mammilate-papillose; marginal and apical cells not different; toward the base progressively larger, more rectangular, and less papillose; cells at base thin-walled, hyaline, rectangular, 15–25 μ wide, up to 3 : 1; margins narrowly recurved from the base to or near the apex, entire except for papillae in upper half; costa yellow to reddish brown, papillose both sides, area of thick-walled cells 35–45 μ wide, percurrent to excurrent in a short, stout mucro. Paroicous; antheridia naked in the axils of the upper leaves; archegonia terminal, with thread-like paraphyses or naked; sporophyte single; urn ovate to long ovate, brown to reddish-brown, 0.7–1.0 mm. long, usually about 0.8–0.9 mm., not wide-mouthed when deoperculate; neck not distinct; stomata at base of capsule; exothecial cells thin-walled, 15–25 μ wide, irregularly rectangular at middle of capsule; mouth bordered by 2–4 rows of thick-walled, smaller cells; annulus not differentiated; lid short-conic to hemispheric; peristome of 16 yellowish-brown, very densely papillose, 0.65–0.163 mm. long, imperfect, narrowly lanceolate and pointed to rather broad and truncate, sometimes irregularly perforate teeth on a low basal membrane; calyptra cucullate, covering about one-half the urn, scabrous with numerous blunt papillae; seta with small central strand, 2–4 mm. long, usually about 3 mm., yellow to reddish, twisted to the right or left; spores yellow, tetrahedral, quite *regularly tuberculate by large, rounded emergences on the curved face, not papillose*, 21–30 μ in diameter; mature in late winter to early spring. Type locality, Europe.

Illustrations:—Bryol. Eur. **2:** *pl. 125*, except the spores; Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 23G;* Braith. Brit. Moss. Fl. **1:** *pl. 29C; Pl. 96.*

Exsiccati:—Sull. & Lesq. Musci Bor. Am. (Ed. 2) 119. This collection also contains material which may be referred to *P. arizonica;* Howe, Musci Californici 79.

On soil. All the specimens seen have been collected in southern California. One specimen reported from "Utah (Watson)" in Lesquereux and James Manual, 103, 1884, has not been seen. Since Lesquereux and James do not mention spore characters it is possible that this specimen was misidentified. Warnstorff in Hedwigia, 1916 lists Sull. and Lesq. 119 in his exsiccati of *P. mutica.* It is possible that the material he examined is that portion which in this monograph is referred to *P. arizonica* (see note under that species).

6. Pottia arizonica Wareham **n. sp.**

Plantae caespitosae, humiles, caule plerumque 1 mm. longo. Folia collata, apicibus patulis vel prope recurvatis, concava, plerumque aliquantulum asymmetrica. Folia superiora 1.0–1.3 mm. longa et 0.5–0.6 mm. lata, ovato-oblonga, breviter-acuminata; folia perichaetialia non dissimilia. Cellulae laminae superiores sexangulares vel quadratae, dense papillosae, 7–13 μ latae; inferiores quadratae vel oblongae, 18–23 μ latae, raro plus quam 2 : 1. Margines laterales revoluto-recurvatae, integerrimae. Costa crassa, 0.06–0.26 mm. excurrens, flava. Paroica, antheridiis nudis in foliorum superiorum axillis. Capsulae plerumque paulo inaequales, deoperculatae 0.9–1.2 mm. longae et ore coarctatae, fuscae; collo maturo subdistincto, annulo deficiente, operculo breviter-conico vel oblique longe-conico, peristomii dentibus 16, imperfectis, plerumque truncatis, papillosis, 60–130 μ longis, fusculo-flavis, in membrana basilari angusta. Seta flava vel rufulo-flava ad 5 mm. longa, flexuosa, dextrorsum torta. Calyptra cucullata, scabra. Sporae flavae, 18–25 μ diam., leves vel papillis minoribus et pustulis minoribus vel pustulis magnis instructae. Differunt plantae ab *P. mutica* sporis non aculeis instructis, peristomio maiore, et costa longe-excurrente.

Plants cespitose; stems 1–3, mostly about 1 mm. long, with central strand, simple or sometimes with one branch, bearing rhizoids below the leaves only; leaves tufted, crowded, as a rule wide-spreading to almost squarrose at the tips when moist, somewhat concave, *mostly somewhat asymmetric*, not lying flat when removed; upper leaves 1.0–1.3 mm. long by 0.5–0.6 mm. wide, mostly ovate-oblong, short-acuminate; progressively smaller toward the base of stem, lowest ones ovate; perichaetial leaves not differentiated; median cells mostly hexagonal, sometimes quadrate, 7–13 μ in diameter, walls thin to fairly thick, chlorophyllose, thickly papillose on both sides with mammillose and branched papillae; marginal and apical cells not different; cells toward the base progressively less papillose, larger and more rectangular; basal cells 18–23 μ wide, thin-walled, mostly quadrate to oblong, seldom more than 2 : 1; margins mostly narrowly to broadly revolute from base to apex or near it, entire except for papillae in upper half; *costa yellow to reddish-yellow, area of thick-walled cells 20–30 μ wide*, papillose on both sides in upper half of leaf, *on some leaves of each plant excurrent into a yellowish awn* 0.06–0.26 mm. long. Paroicous; antheridia 0.13–0.15 mm. long, short-stalked, naked in the axils of the upper leaves; archegonia terminal, naked; occasionally a branch bearing archegonia occurs; sporophytes single or paired; *urn usually slightly unsymmetrical*, 0.9–1.2 mm. long, ovate to long-elliptic, golden brown, narrowed at the mouth when deoperculate; *neck fairly*

distinct when mature, stomata numerous, on the neck; annulus not clearly differentiated; mouth bordered by 2–4 rows of thick-walled, usually quadrate cells; exothecial cells at middle of capsule 20–30 μ wide, quite regularly rectangular, a little over 2 : 1, quite thin-walled on the outside, thick-walled inside; lid conic to long-conic, mostly oblique; *peristome of 16 teeth from a low basal membrane, imperfect, usually truncate, irregularly divided, very papillose, brownish-yellow, 60–130 μ long;* seta with small central strand, yellow to reddish-yellow, about 5 mm. long, flexuose, twisted to the right; vaginula conic, frequently unsymmetric; calyptra cucullate, scabrous with low, blunt papillae, covering one-half to three-fourths of the urn; spores 18–25 μ in diameter, irregular in shape, sometimes somewhat tuberculate, *finely papillose to smooth, thin-walled, yellow, almost transparent*; mature in late January to March. Type locality, shaded banks of dry wash, Tucson Mts., Pima Co., Arizona.—*E. B. Bartram.* Type specimen in herbarium of E. B. Bartram, Bushkill, Penn.

ILLUSTRATIONS:—Pl. *95*.

EXSICCATI:—Bartram, Mosses of So. Ariz. 989 in part (this collection bearing the original label, *Pottia mutica* Vent., has been designated the TYPE); l. c. 744; Bartram, Mosses of Pima Co., Ariz. 990, 990B; Crypt. Coll. John Leiberg 1177, 1166; Holz., Musci Acro. Bor. Am. et Eur. 572 as *P. mutica* Vent. (This is part of Bartram, Mosses of Pima Co. Ariz. 990 and contains both the species and the variety); Sull. and Lesq., Musci Bor. Am. 119 in part, distributed as *P. Starkeana.*

On soil, Arizona and southern California. This species differs from *P. mutica* by a much larger peristome, costa excurrent into an awn and appearing much narrower because of a fewer number of thick-walled cells, more elliptical capsule, usually longer lid, smoother calyptra, and absence of small spines on the spores; from *P. caespitosa* by its paroicous sexual condition and rough calyptra; from *P. Wilsoni* by larger peristome and smoother calyptra; from *P. Starkeana* by less regularly tuberculate, papillose spores, longer capsule, longer lid, and broader leaves with longer awns.

6a. Var. MUCRONULATA Wareham **n. var.**

Plantae a specie nullo modo differunt nisi ut costae subpercurrunt vel breviter excurrunt; foliis plerumque symmetricis pauloque minoribus; peristomio deficiente vel in brevi membrana basilari consistente; operculo plerumque obtuse conico.

Similar to the species with the following exceptions: costa subpercurrent to excurrent in a short mucro; leaves as a rule more symmetric and a little smaller; peristome lacking to consisting of a short basal membrane and operculum usually blunt-conic. Type locality, Tucson Mts., Pima Co., Arizona.—*E. B. Bartram.* Type specimen in herbarium of E. B. Bartram, Bushkill, Penn.

ILLUSTRATIONS:—Pl. *95*.

EXSICCATI:—Bartram, Mosses of So. Ariz. 985 (the TYPE) and many other collections under this label as well as under the label, Mosses of Pima Co., Ariz.; Holz. Musci Acro. Bor. Am. 520 as *P. mutica* var. *gymnostoma* Corb. (This is the same collection as Bartram 747.)

Occurring on soil in pure stands or mixed with the species. Arizona and southern California. Most of the American material labeled *P. mutica* Vent. can be placed in *P. arizonica* or its variety. However, a few specimens have been seen having percurrent costae and a good peristome or awned leaves and a gymnostomous capsule. These plants may represent hybrids. *No American specimens of Pottia having echinate spores have been seen.* Warnstorff, in Hedwigia 1916, lists Sull. and Lesq. Musci Bor. Am. 119 in his *P. mutica* exsiccati. He also lists Erbar. Critt. Ital. Ser. II No. 160 from Triente, Switzerland. Several examples of the latter collection have been seen. The spores are invariably possessed of small spines.

7. POTTIA RANDII Kennedy, Rhodora **1**: 78–80. 1899.

Plants cespitose, up to 15 mm. in height over all; stems without central strand, up to 3 mm. long, seldom branched; leaves tufted, erect; upper leaves *smooth except for occasional mammillose papillae in upper part, oblong to broadly spatulate, short-acuminate,* up to 4 mm. long by 1 mm. wide, usually about 3 x 1 mm., slightly concave; progressively shorter toward the base of stem; two or three next to the archegonia smaller than the tufted ones, entire; cells just above the middle chlorophyllose, oblong to rhomboidal, 15–20 μ wide, mostly about 2 : 1; toward the apex almost square to rhomboidal; progressively longer and wider and hyaline toward the base; a few just above the insertion somewhat inflated; margins entire below, serrulate to serrate from above the middle to the apex; narrowly recurved and 2–3 cells thick from the base to just above the middle, plane at apex; bordered in lower half by 3–6 rows of linear, thick-walled, elongated cells; in upper half to near the apex by elongated, rhomboidal cells; costa strong, percurrent to very shortly excurrent. *Autoicous; antheridia long-stalked,* measuring over all about 0.7 mm., the *stalk sometimes equalling the tube in length;* borne among many somewhat clavate paraphyses, located in the axil of a small,

0.7–1.1 mm. long, costate leaf very near the archegonial tip; archegonia at the tips of the main stem, among numerous paraphyses. Sporophyte usually single, occasionally two occurring together; urn ovate, *unsymmetric, somewhat arcuate,* 0.6–1.3 mm. long; when dry and empty smooth, not wide-mouthed, sometimes slightly contracted below the mouth; neck distinct; stomata on the neck; exothecial cells irregularly quadrate to oblong, 15–20 μ wide, up to 2 : 1, medium thick-walled; annulus of 1–2 layers of very thick-walled, quadrate cells, persistent; *peristome none.* Lid usually oblique, long-conic from an arched base; calyptra smooth, cucullate, covering one-half to three-fourths of the urn; seta with small central strand, 7–10 mm. long, flexuose, yellowish-red, *twisted to the right below* and *to the left above;* spores 24–36 μ in diameter, irregularly shaped, yellowish-red, warty-papillose; mature in early summer. Type locality, Baker Island, near Mt. Desert, Maine.—*Rand,* July 15, 1898.

ILLUSTRATIONS:—Rhod. **1**: 80. *pl. 5.* 1890; Pl. *94.*

EXSICCATI:—Herb. Geo. Kennedy at Farlow Crypt. Herb. (The TYPE. A portion of the type is also located at the New York Botanical Garden); Grout, Musci Perf. 197.

Only three collections are known from North America. The type from Baker Island grew "among stones in sand by the seashore." Grout's 197 was collected by W. S. Flowers on soil in shade, Washington Park, Chicago, Ill. The three collections certainly represent the same species. Matinicus, Maine (*Norton*).

Holzinger in Bryol. **28: 6,** 1925 presents evidence that *P. Randii* is really a gymnostomous form of *Desmatodon cernuus.* In Europe, where several collections have been made, the species is called *Desmatodon Randii.* Although *P. Randii* and *D. cernuus* are remarkably similar in many respects *P. Randii* has *no trace* of a *peristome, much smoother leaves* which are *shorter acuminate,* and a *less excurrent costa.* The similarity to *D. cernuus* in leaf and stem cross section, cell shape and disposition, calyptra, lid, and seta is very striking. In the author's opinion, it is quite possible that the species should be treated as a *Desmatodon.*

8. POTTIA LANCEOLATA (Hedw.) C. Müll. Syn. Musc. **1**: 548. 1849.

Encalypta lanceolata Hedw. Spec. Musc. 63. 1801; and Bry. Eur. *pl. 127.* 1843.
Dicranum latifolium Turn. Musc. Hibern. 79. 1804.
Weisia aciphylla Wahlenb. in Vet. Akad. Nya Handl. **27**: 133. *pl. 4, fig. 1.* 1806.
Grimmia aciphylla Web. & Mohr, Taschenb. 137 and 457. 1807.
Weisia lanceolata Röhl. Deutsch. Fl. (Ed. 2) (3): 51. 1813.
Coscinodon lanceolatus Brid. Musc. Recent. Suppl. **4**: 49. 1819; and Bryol. Univ. **1**: 372. 1826.
Coscinodon aciphyllus Brid. Musc. Recent. Suppl. **4**: 49. 1819; and Bryol. Univ. **1**: 373. 1826.
Coscinodon connatus Kaulf. Mscr. in Brid. Musc. Recent. Suppl. **4**: 50. 1819; and Bryol. Univ. **1**: 374. 1826.
Weisia connata Wallr. in Comp. **3**: 142. 1831.
Dermatodon lanceolatus Hüben. Musc. Germ. 112. 1833.
Desmatodon lanceolatus Bruch, Mscr.; De Not. Syll. 205. 1838.
Tortula lanceolata Lindb. Musc. Scand. 21. 1879.

Sod-forming; stems 2–5 mm. high, with central strand, sometimes branched, usually simple; upper leaves up to 2 mm. long, *broadly lanceolate to more or less oblanceolate,* short- to long-acuminate, keeled, twisted when dry; progressively shorter toward base of stem; median cells chlorophyllose, 12–17 μ wide, irregularly quadrate to hexagonal, *sparingly to quite densely mammilate papillose* on both sides, thin to quite thick-walled and slightly collenchymatous; somewhat smaller toward the apex; toward the base progressively longer and a little wider, smooth, thinner-walled; at the base oblong, up to 5 : 1, one or more rows at the insertion yellowish and somewhat inflated; *margins ordinarily recurved from the base to or very near the apex,* entire at base, serrulate from middle to apex by projecting transverse walls, sometimes papillose near the apex; costa strong, yellowish, *excurrent into a stout, yellowish, usually smooth to serrulate awn 1/10 to 1/3 as long as the lamina, covered on the upper side with enlarged irregularly-quadrate,* thin to thick-walled, *very papillose cells,* smooth or sparingly papillose below. Autoicous; antheridia up to 0.22 mm. long, naked at the tips of very short basal branches tufted with minute, ecostate leaves or in the axils of stem leaves with a few slender, hyaline paraphyses. Archegonia at the tips of main stems or branches; sporophytes single or in pairs; urn up to 1.6 mm. long, reddish-brown, erect, ovate, to narrowly elliptical, irregularly wrinkled and *contracted below the mouth when dry;* not wide-mouthed when deoperculate; neck short but distinct; stomata few, between the neck and the urn; exothecial cells 18–39 μ wide, thin- to thick-walled, irregularly quadrate to oblong; mouth bordered by 3–6 rows of smaller, rounded to quadrate, in-

crassate cells; annulus irregular, of 1–2 rows of very thick-walled pale yellow cells; peristome of 16 very papillose teeth from a low basal membrane, up to 0.32 mm. long, yellowish, inserted just below the mouth; teeth irregularly developed, with a distinct divisural line, *usually cleft at the apex and often perforate;* lid obliquely long-conic to rostrate from a *high-arched base, cells steeply spiraled to the left;* calyptra *smooth,* cucullate, covering one-half to three-fourths of the urn; seta yellowish-red, with central strand, 4–9 mm. long, *twisted to the right below and to the left above;* spores 18–26 μ in diameter, finely warty-papillose, reddish-brown; mature in spring. Type locality, Europe.

ILLUSTRATIONS:—Bry. Eur. l. c.; Dixon Handb. Brit. Mosses, (Ed. 3) *pl. 23J;* Braith. Brit. Moss Fl. **1:** *pl. 29A;* Pl. *97.*

EXSICCATI:—Leiberg, Mosses of Kootnai Co., Idaho as *P. Wilsoni;* Crypt. Coll. John Leiberg presented to U. S. Nat. Museum 264.

The first collection named above bears the following data, "On the ground Cp. Horn Mt. at 3500 ft. alt., Mch. 27, 1890"; the second, "Broken soil, south end of Lake Pend Oreille, Idaho." These are the only collections known from North America.

9. POTTIA NEVADENSIS Card. and Thér. Bot. Gaz. **37:** 365. *pl. 18, figs. 1^{a-e}.* 1904.

Sod-forming; stems with central strand surrounded by a layer of brown cells, erect, simple or branched, 1–3 mm. high; *upper leaves erect, imbricated, not papillose, very concave, ovate to obovate, short acuminate to blunt,* up to 2.5 mm., usually about 2 mm. long, up to 2 mm. wide; shorter below and relatively narrower; median cells sparingly chlorophyllose, thin-walled, irregularly rhomboidal, about 15 μ wide by 30 μ long, toward the apex usually smaller; toward the base progressively larger and less chlorophyllose; extreme basal cells hyaline, thin-walled, oblong, up to 30 μ wide, about 3–1; *margins plain or slightly inrolled* (the original description says "saltem uno latere parce revolutis"), on some leaves entire but *some of the upper leaves of nearly all plants irregularly toothed by projecting rhomboidal cells;* costa yellowish-brown, mostly excurrent into a smooth, slender awn, occasionally ending below the apex. Autoicous; antheridia 0.39 mm. long, among slender, hyaline, 0.52 mm. long paraphyses, each tipped with a cone-shaped, pointed cell, *borne terminally on a short, leafy, basal branch* tufted with minute, up to 1 mm. long, serrate, costate leaves. Archegonia terminal, naked; sporophyte single; urn *gymnostomous, erect, long-ovate,* 0.7–0.9 x 1.2–2.0 mm., not wide-mouthed when deoperculate; *neck short but distinct;* stomata on the neck; lid obliquely rostrate from an arched base, *attached to columella;* exothecial cells thick-walled, mostly irregularly oblong, 15–23 μ wide, 1 : 2 to 1 : 3 at middle of capsule; mouth bordered by 1–4 rows of much smaller, transversely-elongated cells; annulus of 1–2 rows of small, almost round, very pale yellow, thick-walled cells, persistent; calyptra smooth, cucullate, covering about one-half the urn; seta with central strand, pale yellow to yellowish-red, *twisted to the left,* 8–12 mm. long; spores very finely papillose, reddish-brown, 19–31 μ; ripe in late spring to early summer. Type locality, Ormsby Co., Nevada.—*C. F. Baker.*

ILLUSTRATIONS:—Bot. Gaz. **37:** l. c. Pl. *93.*

EXSICCATI:—C. F. Baker, Plants of Nevada 959 (the TYPE or COTYPE); Holzinger, Musci Acro. Bor. Am. 155; Macoun, Flora Can. 220, as *P. intermedia,* 111 as *P. truncata* var. *subcylindrica* and Can. Musci 330 as *P. litoralis;* many specimens of Macoun, Can. Musci 62, as *P. truncata* (see notes below); Flowers, Flora of Utah 1200; U. S. Geol. Ex. 40th Par. 1381 as *P. truncata.*

Flowers' collection was made on "dry, saline soil, east shore of Great Salt Lake." None of the other collections bear habitat data other than "on earth" except Macoun's 62 from the Gaspé Coast. Material distributed under this number was apparently collected in three parts of Canada (see notes under *P. truncata*), and it seems to be almost impossible, at this date, to be sure of their origin. In Mitten's Herbarium, now at New York Botanical Garden, a packet of Can. Musci 62 labeled *P. litoralis* is *P. nevadensis.* The distribution seems to be definitely Western. Specimens of unquestionable origin are known only from Utah, Nevada; British Columbia, and either Saskatchewan or Alberta in Canada. The location of the latter is simply "Athabaska Plains."

10. POTTIA HEIMII (Hedw.) Fürn. Flora **12^2:** 10. 1829.

Gymnostomum Heimii Hedw. Spec. Musc. 32. 1801.
G. obtusum Turn. Musc. Hib. 9, *pl. 1.* 1804.
G. affine Bryol. Germ. **1:** 140. *pl. 9, fig. 9.* 1823.
Pottia affinis Fürnr. Flora **12^2:** 10. 1829.
P. Heimii var. β *cylindrica* Bry. Eur. *pl. 124.* 1843.
P. Heimioides Kindb.; Macoun Cat. Can. Pl. **6:** 43. 1892.

Didymodon heimioides Kindb. Europ. and N. Amer. Bryin. 280. 1897.
D. Heimii (Hedw.) Kindb. l. c.
Desmatodon systilioides Ren. & Card. Bot. Gaz. **30**: 16. 1900.
Pottia Heimii var. *beringiana* Card. & Thér. Proc. Wash. Acad. Sci. **4**: 301, *pl. 14, figs.* 2^{a-i}. 1902.

Forming sod up to 8 mm. deep; stems with a large central strand, radiculose at base, branched or simple; upper leaves erect, imbricated to somewhat spreading, 2.5–3.3 x 0.52–1.0 mm., ovate to ovate-lanceolate to long-lanceolate, short-acuminate to long-acuminate or acute, strongly concave, somewhat keeled; median cells usually almost obscured by many so-called c-shaped papillae on both sides, occasionally nearly smooth, hexagonal to rounded-quadrate, thick-walled, 9–20 μ wide; basal cells much larger, smooth, lax, thin-walled, hyaline, rather sharply distinguished from the median; leaves *usually bordered above by 2–5 rows of sometimes thicker-walled, oblong to rhomboidal, less papillose, yellowish cells;* bordered below by 2–4 rows of very narrow, elongated cells; *margins plane*, entire below, papillose at middle, and *usually more or less toothed by projecting transverse walls or by projecting cells at apex;* costa strong, subpercurrent to short-excurrent; leaves progressively shorter, broader in proportion to the length and less differentiated toward the base of stem. *Polyoicous;* archegonia and antheridia borne terminally; purely male stems or branches bearing 0.26–0.34 mm. long antheridia among many, almost clavate paraphyses, each tipped with a cone-shaped, pointed cell; purely female stems or branches bearing a few archegonia and occasionally a few paraphyses; bisexual stems or branches bearing both archegonia and antheridia and a few paraphyses; seta with central strand, yellow to reddish brown to red, 4–16 mm. long, *twisted to the left* for most of the upper length, sometimes to the right at the base; calyptra cucullate, *smooth*, falling early, covering about one-half the urn; urn ovate to long-cylindric, 1.0–2.7 x 0.5–0.9 mm., not wide-mouthed when deoperculate, *gymnostomous*, neck short, distinct; stomata on the neck; lid conic to long-rostrate from a high-arched base, erect or oblique, *systylous;* exothecial cells at middle of capsule quadrate to oblong, 1 : 1 to 1 : 6, 15–30 μ wide, medium thick-walled; mouth bordered by 1–3 layers of smaller, rounded-quadrate cells; annulus of 1–2 layers of small, rounded, very thick-walled cells, persistent either on the lid or the capsule mouth; spores yellowish to reddish-brown, papillose, 19–39 μ in diameter; mature in late spring. Type locality, Europe.

Illustrations:—Bryol. Eur. *pl. 124*, incl. varieties; Warnst. in Hedwigia **58**: 96–100, *figs. 17, 18, 19, 20, 21;* Dixon Handb. Brit. Mosses (Ed. 3) *pl. 22J;* Braith. Brit. Moss Fl. **1**: *pl. 28D; Pl. 97.*

Exsiccati:—Canadian Musci 577 (some of the material distributed under this number is *Didymodon recurvirostris*); U. S. Geol. Explor. of 40th Parallel under Clarence King 1382; Sull. and Lesq. Musci Bor. Am. (Ed. 2) 115 (usually mixed with *Didymodon recurvirostris*); Mosses of Colorado Dist. by J. M. Holzinger (Not numbered. Some material distributed under this label is *Tortula* sp.); Palliser's Brit. North Amer. Expl. Exped. Rocky Mts. (as *Desmatodon Heimii*, no number); Drumm. Musci Am. 13, 14, 15; Plantae Groenlandicae from Western Greenland (No number. This approaches the var. *obtusifolia*); Alaska Musci—Kincaid 47, 51 as the var. *beringiana;* The Harriman Alaska Expedition—Trelease 2151 as var. *beringiana;* U. S. Nat. Herb., Mosses of Yellowstone Nat. Park (not numbered).

Usually on moist alkaline and saline soils, frequently a sea coast plant. In North America known from New Mexico, Colorado, Utah, Wyoming, Montana, Idaho, Washington, Alberta, Ontario, Newfoundland, Northwest shore of Hudson's Bay, St. Paul and St. Matthew Islands in the Bering Sea, and Greenland. This is truly a portean species. Many varieties and forms have been described. Warnstorff in Hedwigia l. c. left nothing in the species but referred all specimens to 13 varieties and 2 forms, based principally on leaf form and shape. It is, however, almost, if not quite impossible to draw any lines which will sharply delimit these varieties. In the same colony and often on the same plant may be found leaves bordered and non-bordered, with toothed and nearly entire margins, densely papillose to almost smooth. One specimen examined was quite papillose on one side of the costa while the cells on the other side were nearly smooth. In the same colony may be found ovate to long-cylindric capsules, long and short setae. There seems to be no consistent relation between the length of the setae and the shape and size of the capsules, i. e., long setae and short capsules, long setae and long capsules, short setae and long capsules, short setae and short capsules occur. Moreover, these variations in the sporophyte occur with various leaf shapes and sizes. Even the variety *obtusifolia*, which in some collections is very distinct, may possibly be an ecological variation or a hybrid segregate. A series grading from the long-acuminate form to the very obtuse form may be prepared easily. Collections having broadly obtuse and acute leaves on the same plant have been seen.

P. heimioides Kindb. in Macoun, l. c., described as resembling *P. Heimii*, but differing principally in having a rudimentary peristome, was probably based on the gametophyte of *P. Heimii* and old capsules of *Didymodon recurvirostris* (Hedw.) Jenn. Both species have been found associated in specimens named by Kindberg and cited by Warnstorff l. c., who illustrated *P. heimioides*, p. 125, *fig. 42*. Warnstorff states that Sull. and Lesq., Musci Bor. Am. 115, in the herbarium at Berlin as *P. Heimii*, is *P. heimioides*. This number in the New York Botanical Garden is a mixture of *P. Heimii* and *D. recurvirostris*. In the Ohio State University herbarium it is a mixture of *P. Heimii* and *Tortula* sp. In none of the dozen or so specimens named *P. heimioides* in the various herbaria in the United States and Canada were any peristomate specimens found. The name must be relegated to synonomy.

10a. Var. OBTUSIFOLIA (R. Brown) Hagen in Musci Norv. Bor. 45. 1899.

Gymnostomum obtusifolium R. Brown Suppl. append Itin. Parryan. 299. 1824; and Schwäg. Suppl. **2²**: 82. 1826.
Pottia obtusifolia C. Müll. Synop. Musc. **1**: 556. 1849. (Not p. 559.)
P. Heimii var. *arctica* Lindb. in Öfvers. K. Vet. Akad. Förh. **23**: 551. 1866.
P. Ryani Philib. in Rev. Bryol. **23**: 28. 1896.
Didymodon Heimii Ryani Kindb. in Europ. and N. Amer. Bryin. 280. 1897.
Pottia papillosa Harmsen in Meddel. om Grøn. **82²**: 24. 1932.

Plants gregarious or cespitose; leaves erect, usually shorter than the species, very concave to cucullate, orbicular, ovate, oblong or lingulate, with apices rounded to short-apiculate; margins mostly entire to crenulate, sometimes weakly toothed; costa ending below the apex or in the apiculus; urn ovate to short-cylindric, up to 1.5 mm. long, sometimes wide-mouthed when deoperculate; lid short-conic to obliquely short-rostrate. Type from Melville Island. Specimen in Schwägrichen's Herbarium.

ILLUSTRATIONS:—Schwäg. l. c. *pl. 176;* Harmsen l. c.; Warnstorff in Hedwigia **58**: 100–101, *figs. 22, 23*. 1916.

EXSICCATI:—Acad. Sci. Phila., Exped. to Green. in 1891. (Portions of the collection bearing the label *P. Heimii* var. *arctica* are this variety. It is mixed with *P. Heimii*); Herb. Geol. Sur. Can. Arctic Exped. in 1913–1916, Cape Bathurst, Canada. Coll. Frits Johansen, July 26, 1916. (This specimen has some acute leaves but is pretty good var. *obtusifolia*.)

On soil, in pure stands or with the species. All our collections are from the Arctic Region: Cape Bathurst, Northwest Territories; Melville Island; and Whale Sound, Greenland.

11. POTTIA LATIFOLIA (Schwägr.) C. Müll. Syn. Musc. **1**: 549. 1849.

Weisia latifolia Schwägr. in Schultes Reise Grossglockner Append. to Vol. 4. 1804; and Schwägr. Suppl. **1**: 64. *pl. 18*. 1811.
Grimmia latifolia Web. & Mohr, Taschenb. 147. 1807.
Anacalypta latifolia Fürnr. in Flora **12²**: 25. 1829.
Dermatodon latifolius Hüben. Muscol. Germ. 116. 1833.
Desmatodon bulbosus De Not. Syllab. 203. 1838.
Didymodon bulbosus Hartm. Skand. Fl. (Ed. 4) 382. 1843.
Pottia (Hyalophyllum) pilifera β *mutica* Lindb. de Tort. 223. 1864.
Tortula bullata β *mutica* Lindb. Musc. Scand. 21. 1879.
Stegonia latifolia Vent. in Rev. Bryol. **10**: 96. 1883.
Hyalophyllum latifolium (Schwägr.) Warnst. in Hedwigia **53**: 284. 1913.

In loose clusters or forming sods, *bulbiform*, light green to silvery; stems with large central strand, 1–2 mm. long, usually branched at base; *upper leaves imbricated, smooth, apiculate to obtuse, broadly oval, with a narrower, sheathing base*, up to 2 mm. long; progressively shorter toward the base, the lowest ones orbicular or wider than long; leaves under low magnification *appear to be divided transversely at about the middle into a small-celled, yellowish portion above and a hyaline, large-celled portion below;* cells of the upper half irregularly rhomboidal, 9–15 μ broad, up to 2 : 1, thin-walled to incrassate, containing very few, small chloroplasts; *walls on the under side very thick*, up to 11 μ, *yellow;* upper walls thin; cells at the apex smaller, incrassate, often colorless; cells of the lower half irregularly oblong, 15–30 μ wide, up to 4–1, walls yellow and of the same thickness on all sides; margins usually plane, occasionally narrowly recurved, entire below, entire or serrulate near the apex; costa yellowish, usually ending several cells below the apex. Autoicous; antheridia 0.32–0.35 mm. long, at the tips of leafy, basal branches; paraphyses few or none, very slender, hyaline; archegonia few, terminal; sporophytes single; urn brown, 1.1–1.8 mm. long, erect, symmetrical to slightly arcuate, oval to long-elliptic, narrowed at the mouth, usually contracted below the mouth and irregularly wrinkled when dry; seta with central strand, 4–10 mm. long, yellow to brownish red, twisted to the right below and to the left above; exothecial cells thick-walled, irregularly oblong, 15–31 μ wide, up to 4 : 1 at middle of capsule, shorter above and below; mouth bordered by 1–4 rows of smaller, incrassate, darker colored cells; neck tapering, rather indistinct; stomata on the neck; annulus of 1–3 rows of lighter colored, irregularly shaped, very thick-walled cells, persistent; lid obliquely short- to long-rostrate, from a low-arched base; peristome of 16 narrow, papillose, yellow-brown teeth, 0.16–0.23 mm. long, split at the apex and often perforate along the divisural line; basal membrane very low, not appearing above the mouth;

calyptra smooth, cucullate, covering about one-half the urn; spores 33–48 μ in diameter, finely warty-papillose, reddish-brown; mature in spring and early summer. Type locality, Switzerland.

ILLUSTRATIONS:—Bry. Eur. *pl. 128;* Schwägr. Suppl. l. c.; Dixon Handb. Brit. Mosses (Ed. 3) *pl. 23K;* Braith. Brit. Moss Fl. *pl. 30B; Pl. 95 & 96.*

EXSICCATI:—Drumm. Musci Bor. Am. 70; Macoun, Can. Musci 162; U. S. Geol. Ex. of 40th Par. 138. Bayard Long, Mosses of Newfoundland 373.

On soil or rocks. Considered to be Arctic and Alpine in distribution. Colorado, Wyoming, Nevada in the United States; Rocky Mountains in Canada; St. Johns; Greenland. The following collections have been erroneously called *P. latifolia:* Canadian Musci Ex. Herb. Geol. Survey, 158 is *Desmatodon latifolius;* and Cryptogamic Coll. John Leiberg, presented to U. S. Nat. Museum, 329 is *Pterigoneurum ovatum.*

11a. Var. PILIFERA (Brid.) C. Müll. Syn. Musc. **1**: 550. 1849.

Coscinodon pilifer (Funck) Brid. Bryol. Univ. **1** (Suppl.): 810. 1826.
Dicranum bullatum Sommerf. Suppl. Fl. Lapp. 1826.
Weisia pilifera Funck, Mscr. in Wallr. Comp. **3**: 149. 1831.
Anacalypta latifolia β *pilifera* Bryol. Germ. **2**^{2}: 137. 1831.
Dermatodon Funckii Hüben. Musc. Germ. 115. 1833.
Pottia (*Hyalophyllum*) *pilifera* Lindb. de Tort. 223. 1864.
Tortula bullata Lindb. Musc. Scand. 21. 1879.
Hyalophyllum latifolium var. *piliferum* (Brid.) Warnst. in Hedwigia **53**: 284. 1913.

Like the species except that the costa is excurrent into a hyaline, piliferous awn from 0.5 to 1.5 mm. long and from one-fifth to as long as the lamina.

ILLUSTRATIONS:—Bryol. Eur. *pl. 128. Pl. 95.*

EXSICCATI:—Drumm. Musci Am. 70; Williams, Plants of Yukon Territory 564.

In pure stands or with the species. Rarely specimens occur having shorter awns than is the rule and having both awned and non-awned leaves on the same plant. Known from Alaska and from the Rocky Mountains in Canada.

4. PTERIGONEURUM Juratzka, Laubmfl. Oesterr.-Ung. 95. 1882.*

R. T. Wareham

Plants small, forming convex sods or expanded turfs, usually gray-green because of the hyaline hair-points; leaves erect, imbricated, very concave, ovate to obovate to spatulate, acuminate or obtuse at apex; margins usually involute, plane or somewhat recurved, usually toothed or lobed at or near apex, otherwise entire; costa excurrent as an elongated hyaline hair which is sometimes longer than the lamina but often much shorter; *costa bearing on the upper surface* (*usually 4*) *chlorophyllose lamellae,* widest near the apex and tapered to one cell high at the base of the leaf, usually toothed by projecting cells above and sometimes bearing protonema-like projections; median cells irregularly quadrate to transversely elongated, usually with fairly thick walls which are thicker on the underside of the leaf and somewhat collenchymatous, papillose or smooth on the back; basal cells larger, rectangular, quadrate to elongated longitudinally, smooth on both sides, thin-walled and often hyaline; apical cells quadrate or round to rhomboidal, often hyaline. Autoicous; antheridia in the axils of minute ecostate or weakly costate but not awned leaves, located either below the perichaetial leaves or on short branches near the base of the stem; paraphyses filamentous or clavate. Capsule immersed to long exserted, symmetrical, subglobose to oblong-cylindric; stomata superficial, in a row at the base of the capsule; exothecial cells irregularly rectangular, large; annulus lacking, indicated by 2–4 rows of round, thick-walled cells, or coming off as single cells; peristome lacking or present; operculum rostrate from a convex base. Calyptra smooth, mitrate or cucullate. Spores smooth to densely papillose, ripening in early spring. Type species, *P. subsessile.*

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KEY.

1.	Sporophyte immersed to emergent, calyptra mitrate	2.
	Sporophyte emergent to exserted, calyptra cucullate	3.
2.	Spores densely papillose, leaves usually papillose on the back, apex not, or only slightly, lobed	*1. subsessile.*
	Spores smooth to slightly papillose, apex of leaf variously lobed	*1a.* var. *Henrici.*
3.	Peristomate, cells of lid obliquely twisted to left, leaves papillose on back, capsule long exserted	*3. lamellatum.*
	Gymnostomous, cells of lid almost parallel to longitudinal axis, leaves smooth on back.	*2. ovatum.*

1. PTERIGONEURUM SUBSESSILE (Brid.) Jur. Laubmfl. Oesterr.-Ung. 96. 1882.

Gymnostomum subsessile Brid. Sp. Musc. **1**: 35. 1806.
G. acaule Flörke in Web. & Mohr, Taschenb. 79 and 455. *pl. 6, fig. 4–8.* 1807.
Schistidium subsessile Flörke, Bryol. Germ. **1**: 92. *pl. 8, f. 1.* 1823.
Pottia subsessilis Bryol. Eur. fasc. 18–20. *pl. 117.* 1843.
Fiedleria subsessilis Rabenh. D. Kryptfl. (Ed. 1) **2**[3]: 96. 1848.
Pharomitrium subsessile Schimp. Syn. (Ed. 1) 121. 1860.
Tortula subsessilis Mitt. Jour. Linn. Soc. **12**: 164. 1869.

Plants forming compact, gray-green sods; stems simple or branched, up to 5 mm. high, usually 2–3 mm.; stem leaves erect, imbricated, obovate, obtuse to acuminate, up to 1.7 mm. long, very concave to cucullate; costa excurrent into an awn as long as or longer than the lamina; awn usually *rough* by projecting cells but occasionally smooth as in *P. ovatum;* 4 chlorophyllose lamellae on the upper side of costa, each approximately half as wide as one side of the lamina near apex and tapered to one cell high at base of leaf, *seldom bearing protonema-like* projections, standing at various angles to the lamina or lying parallel; median cells irregularly rounded, quadrate or transversely elongated, about 15 μ wide, usually thick-walled and collenchymatous, papillose on the back (the last three characters not evident in some specimens); basal cells larger, quadrate to longitudinally elongated, thinner-walled, and often hyaline; apical cells quadrate to round to rhomboidal, usually incrassate, sometimes a greater or less area hyaline; margins plane, *entire except for toothed or slightly lobed apex;* perichaetial leaves similar, often less convex, one or two, in some plants consisting largely of a rough awn. Autoicous; antheridia in the axils of minute, ecostate or weakly costate but not awned leaves, located at various places below the perichaetium or at the tips of so-called false branches, paraphyses filamentous, hyaline; capsules immersed to emergent, urn 0.4 to 0.7 mm. long, globose to subglobose, sometimes wider than long, irregularly wrinkled when dry, wide-mouthed, the mouth expanding when the lid falls, sometimes allowing the lid to fall into the cavity; gymnostomous; exothecial cells irregularly rectangular, longer than wide, thin-walled; annulus only indicated by 2–4 rows of smaller, rounded, incrassate cells; lid conic-rostrate, rostrum erect or oblique; calyptra mitrate, split into 3–5 lobes, occasionally appearing almost cuculate by splitting more on one side than the other; seta usually about 0.2 mm. long but occasionally equalling the length of the capsule; peristome lacking; spores 30–55 μ, papillose, with papillae thick enough to render the spores opaque in most specimens, maturing in early spring.

Type locality, Europe.

ILLUSTRATIONS:—Schwaegr. Suppl. **1**: *pl. 7;* Bry. Eur. *pl. 117;* M. H. M. 160, *f. 74.*

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1, 1856) 92, (Ed. 2) 118; Macoun Flora Can. 2323; Holz. Musc. Acro. Bor. Am. 230; Bartram, Mosses So. Ariz. 116.

On soil or rocks in exposed situations; Western North America, east to Illinois.

An extremely variable species, grading into the var. *Henrici.* Some specimens difficult to place, having some characteristics of the species and some of the variety. It is possible that the variety should be included in the species. A collection in the New York Botanical Garden made by E. Hall in Nebraska contains two extremes: one with the seta equal in length to the almost 0.8 mm.-long, globose capsule; the other having a normal sporophyte but most stem leaves having very low, papillose lamellae. The leaf apices on this specimen are also extremely variable, from lobed to entire and from obcordate to acuminate.

1a. Var. HENRICI (Rau) Wareham **n. comb.**

Barbula Henrici Rau, in Bull. Washburn Laboratory, Kansas **1**: 172. 1886.
Crossidium Henrici (Rau) Broth., Paris, Ind. Bryol. (Ed. 2) **1**: 356. 1904.
Pterygoneurum Henrici (Rau) E. G. Britton, Holzinger and Bartram in Bryol. **26**: 68. 1923.

Differs from typical *P. subsessile* in being smaller in all parts except spores. Leaves averaging about 0.7 mm. long, narrower than *P. subsessile; apex of many leaves lobed*, hyaline; capsule subglobose, 0.5 mm. wide at mouth; spores *smooth* to extremely minutely papillose, comparatively thin-walled, 30–40 μ. Type locality, Saline Co., Kansas. Coll. Joseph Henry. *Pl. 99.*

Exsiccati:—Type specimen collected by Joseph Henry, New York Bot. Gard.

In the original description by Rau the habitat is given as "on rocks." Judging by the appearance of the specimen, the rocks are sandstone. This moss was originally described as "dioecious" and "sterile." From notes by Mrs. Britton found with the specimen in the New York Botanical Garden, it is apparent that she examined the specimen carefully and sent parts of it to Holzinger and Bartram. All found antheridia, and Mrs. Britton found and sketched a lid. The author in re-examination of this material found several capsules containing spores, one of which still had the lid attached. These capsules were at least a year old and were covered by the accumulation of soil and sand. The author with hesitation retains this species as a variety. Considering the variability of *P. subsessilis*, it is entirely possible that it should be reduced to synonomy.

2. Pterigoneurum ovatum (Hedw.) Dixon, Rev. Bryol. et Lichenol. **6**: 96. 1933.

Bryum pusillum Hedw. Fund. Musc. **2**: 32. 1782.
Gymnostomum pusillum Hedw. l. c. 87.
Pottia cavifolia Ehrh. Beitr. **1**: 187. 1787; Bryol. Eur. fasc. 18–20. *pl. 118.* 1843.
Gymnostomum ovatum Hedw. Sp. Musc. 31. 1801.
Pottia pusilla Lindb. in Öfvers. Vet. Ak. Förh. **20**: 410. 1863.
Tortula pusilla Mitt. Jour. Linn. Soc. **12**: 165. 1869.
Aloina pusilla Kindb. Laubm. Schwed. u. Norw. 137. 1883.
Pterygoneurum cavifolium (Ehrh.) Jur. Laubmfl. 96. 1882.
Pterygoneurum pusillum (Hedw.) Broth. in Mönkemeyer, Krypt. Fl. 319. 1927.
Pterygoneurum cavifolium var. *β incanum* (Bryol. Germ.) Jur. Laubmfl. 96. 1882.

Plants forming broad, low sods, light green, bulbiform; stems simple or branched, up to 5 mm. high, usually about 3 mm.; upper leaves imbricated, very concave, ovate to obovate, usually acuminate, up to 1.4 mm. long; costa excurrent into an awn, usually much shorter but occasionally as long as or longer than the lamina; awn usually smooth but in some specimens roughened by projecting cells; lamellae 2, 4, or sometimes 6, each measuring half or less than half as wide as one side of the lamina at the apex and tapered to one cell high at the base of the leaf, *usually bearing protonema-like projections*, standing at various angles to the lamina or lying parallel; median cells rounded-quadrate to hexagonal, almost collenchymatously thickened, about 12 μ in diameter, *not papillose on the back;* basal cells elongated-rectangular, thinner-walled, sometimes hyaline; apical cells smaller than the median, usually rhomboidal, occasionally a few near the costa hyaline; margin entire, plane or sometimes slightly recurved; perichaetial leaves similar except that in many specimens the *awn* is *shorter than in the lower leaves.* Autoicous; antheridia in the axils of minute, usually ecostate leaves, located at various levels below the perichaetium; paraphyses usually somewhat clavate; capsules emergent to long exserted, ovate to oblong-cylindric, irregularly folded when empty; urn 0.7 to 1.5 mm. long, wide-mouthed, gymnostomous; exothecial cells irregularly rectangular, longer than wide, fairly thick-walled; annulus indicated only by 2–4 rows of smaller, rounded, incrassate cells; lid rostrate from a convex base, usually oblique, cells of rostrum parallel to longitudinal axis or very slightly inclined to the left; calyptra cucullate; seta 1.5 to 7 mm. long, usually 3–5 mm.; spores densely papillose, 18–34 μ; maturing in early spring. Type locality, Europe.

Illustrations:—Braith. Brit. Moss. Fl. **1**: *pl. 30C;* Bry. Eur. *pl. 118;* Dixon Handb. Brit. Mosses (Ed. 3) *pl. 23L.; Pl. 98.*

Exsiccati:—Macoun, Can. Musci, 17 & 18; U. S. Geol. Ex. 40th Par. 1379; Holz. Musc. Acro. Bor. Am. 231 and No. 85, which was dist. as var. *incanum;* Bartram Mosses of So. Ariz. 773; Grout, Musci Perf. 338.

On alkaline or non-saline soil in exposed situations; western North America, east to North Dakota.

An extremely variable species. Forms having long awns and short setae were formerly designated as the var. *incanum.* The author, however, finds this combination of characters inconstant in both American and European material.

Bartram's Mosses of So. Ariz., 774, distributed as *P. cavifolium* var. *incanum* has a combination of characters not found in any other specimen examined or described. If rediscovered it may be worthy of description as a species. Leaves papillose at back; awn rough, long excurrent; lamellae papillose and protonematose; capsule scarcely exceeding the awns in height; gymnostomous; cells of lid slightly twisted to left; spores 30–45 μ, minutely but densely papillose.

3. PTERIGONEURUM LAMELLATUM (Lindb.) Jur. Laubmfl. 97. 1882.

Gymnostomum ovatum var. *β gracile* Hook. & Tayl. Musc. Brit. 12. 1818.
Pottia cavifolia var. *δ barbuloides* Durieu, Mscr. Schimp. Coroll. 24. 1856.
Tortula lamellata Lindb. de Tort. 233. 1864.
Barbula concava Schimp. Flora. **47**: 210. 1864.
Barbula cavifolia Schimp. Syn. (Ed. 1) Add. 744 *ex parte*, 1860; Bry. Eur. Suppl. *pl. 32*. 1866.
Pottia barbuloides Durieu, in Husnot, Musc. Gall. 74. 1885.

Plants in gray-green sods, scarcely 1 cm. deep, usually about 5 mm.; stems simple; upper leaves concave, obovate to lingulate-spatulate, short acuminate, erect and loosely imbricated when wet, up to 1.9 mm. long, more or less crisped when dry; costa excurrent into a *smooth to slightly roughened awn* varying in length from very short to as long as or longer than the lamina; lamellae 4, chlorophyllose, *papillose, bearing protonemata* on the sides, irregular in shape, widest near the apex, tapered to 1 cell high at base of leaf, standing at various angles or lying parallel to the lamina; median cells rectangular to quadrate, about 13 μ wide, somewhat thickened and *papillose on the under side;* basal cells larger, rectangular, thinner-walled; apical cells roundish quadrate to rhomboidal, smaller than the median; margins sometimes serrate at apex, otherwise entire, *somewhat recurved* to near the apex; lower leaves smaller, ovate; perichaetial leaves not differentiated. Autoicous; antheridia in buds near the base of fruiting stems, surrounded by minute leaves, the innermost ecostate; paraphyses almost clavate with pointed end cells; capsules long-exserted, erect, oblong to cylindrical, symmetrical to slightly curved, irregularly folded when dry, the mouth not wide when ripe and empty, urn 0.8 to 1.7 mm. long; exothecial cells irregularly rectangular, longer than wide, comparatively thin-walled; annulus of one or two layers of cells coming off as separate cells, not a definite single layer as shown in the Bryologia Europea plate; lid obliquely rostrate, the cells strongly twisted to the left; peristome inserted at the mouth, yellowish and finely papillose, usually remaining in the falling lid; basal membrane low, teeth (32 and more) equally distant, of unequal height, straight or slightly twisted to the right, thread-like, nodose, bound together below irregularly by 2 and 3 cross articulations, above reduced to 16 teeth whose nodose fragments extend far into the rostrum; calyptra cucullate; seta 3–10 mm. long; spores 14–20 μ, extremely finely papillose, maturing in spring. Type locality, Europe.

ILLUSTRATIONS:—Bry. Eur. Suppl. *pl. 32;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 24A;* Braithw. Brit. Moss Fl. **1**: *pl. 30D; Pl. 98.*

EXSICCATI:—Bartram, Flora of Pima Co., Ariz. Nos. 6, 18 & 23.

These specimens are located in the herbarium of E. B. Bartram at Bushkill, Pa.

On exposed soil, Arizona and Utah. The Utah specimen was collected by A. O. Garrett on an alkali flat west of Salt Lake City. It consists of one plant and is in the Bartram herbarium. The description of the peristome above was translated from Limpricht's Laubmoose, 1888. The only change is in the use of the terms "right" and "left" to conform to the usage as defined in the glossary, page 44 of Grout's M. H. M.

5. ALOINA (C. Muell.) Kindb. Bih. Sv. Vet.-Akad. Handl. **7**⁹: 136. 1883.

Mrs. Ethelda J. Craig

Barbula Sect. *Aloideae* Fuernr. Flora **12**: 598. 1829.
Barbula Sect. *Aloina* C. Muell. Syn. Musc. **1**: 596. 1849.
Barbula Subg. *Tortula* Schimp. Coroll. Bryol. Eur. 31. 1856.
Tortula 1. *Aloidella* DeNot. Musc. Ital. **1**: 14. 1862.
Aloidella Vent. in Comm. d. Fauna, Flora etc. Venezia No. 3. 1868.
Barbula Subg. *Aloidella* Schimp. Syn. (Ed. 2) 188. 1876.

Plants growing in tufts or clusters on the ground, small, bud-like, few-leaved, biennial, lime loving; stem very short, mostly simple, central strand wanting, tissue (in cross section) fairly uniform and thin-walled, its walls without pits or thin spots; rhizoids only at base, colorless; leaves stiff and thick, when dry mostly curved inward, when moist somewhat expanding, seldom adjacent or close, when old mostly reddish brown, tubular above the sheathing and hyaline base through the involute edges, or very concave; the margin ~~plain~~, not bordered; the apex usually blunt, mostly cucullate, mostly without hair-point; costa very wide, about half as wide as blade, mostly not excurrent, in cross section 3–5 layers thick at the insertion, most strongly developed in *A. aloides;* somewhat higher up and adjacent to the dorsal cells are groups of stereids, which still farther up on the leaf limb fuse into a band which then occupies the space between the dorsal and the

ventral cells; guide cells not differentiated from the ventral cells, no accompanying or companion cells present; upper surface of the vein of the leaf limb covered with thread-like photosynthetic filaments; these filaments dichotomously branched, septate, green, their end cells pointed and thick-walled; lamina of one layer of cells; these cells weak in chlorophyll, smooth, those of leaf limb thick-walled especially the dorsal surface, quadrate, more or less wider than long, toward margin hyaline; cells of the leaf sheath hyaline, rectangular to elongate, thin-walled. Dioicous, seldom synoicous; male plants very small, intermingled with the female plants; perichaetial leaves somewhat larger, otherwise not differentiated; inflorescence terminal, bud-like, paraphyses longer than sex organs, filamentous to almost clavate; calyptra long-beaked, cuculiate, smooth; seta elongate, twisted to right below and to left above; vaginula elongate and cylindrical; capsule mostly erect and regular, short-necked; stomata in the neck, in one row, with a roundish opening; cells of epidermis elongate, often many of them thick-walled; annulus differentiated, often persistent; lid beaked, mostly inclined; peristome teeth 32, spirally twisted to the left, papillose, not knotty or jointed, with low basal membrane; spores 10–27 μ. Type species, *A. aloides.*

All our species are alike in the abundance and length of the photosynthetic filaments on the upper surface of the leaf limb. The filaments are 2–5 cells high. Likewise all our species have a similar habitat.

Key.

A. Synoicous; leaves erect, close when dry or moist, peristome teeth twisted once..... *1. brevirostris.*
AA. Dioicous; leaves curled-in when dry, spreading when moist.
B. Leaves 1.12–2.4 mm., broadly oblong; peristome teeth twisted 2–3 times.
C. Costa vanishing at blunt apex..... *2. rigida.*
CC. Costa extending into long hair..... *2a.* var. *pilifera.*
BB. Leaves 2.6–3.6 mm., linear-lanceolate; peristome teeth twisted once.
D. Calyptra reaching base of lid; capsule erect; basal membrane of peristome 5 cells high..... *3a.* var. *ambigua.*
DD. Calyptra reaching almost to middle of urn; capsule inclined; basal membrane of peristome 1–3 cells high..... *3. aloides.*

Aloina brevirostris (Hook. & Grev.) Kindb. Laubm. Schwed. u. Norw. 137. 1883.

Tortula brevirostris Hook. & Grev. Edinb. Jour. Sci. **1**: 289. 1824.
Barbula rigida var. *brevirostris* Brid. Bryol. Univ. **1**: 824. 1826.
Barbula brevirostris Bruch. Mueller in Flora **12**: 406. 1829.
Tortula enervis Hartm. Skand. Fl. (Ed 2) 323. 1832.
Barbula macrorhyncha Kindb. in Macoun, Cat. Can. Pl. **7**: 50. 1892.
Aloina macrorhyncha Broth. in Engler & Prantl. Nat. Pfl.-Fam. (Ed. 2) **10**: 295. 1924.

Plants in small clusters, very small, bud-like when wet or dry, pale green or in age reddish brown; stem simple, very short, about 0.56 mm.; lower leaves very short, about 0.56 mm., ovate, obtuse; upper leaves 1–2.4 mm. long, 0.64–1.08 mm. broad, broadly oblong, obtuse and very concave; leaves erect; the margin involute above and rounded at tip, hyaline, not bordered; apex cucullate; costa 2/5–2/3 the width of the leaf at middle of limb, rather thin, not excurrent; photosynthetic filaments on limb very abundant, 3–5 cells long; median cells of leaf limb at ½ up about 19 μ long and 28 μ wide, vertically compressed so as to be transversely oblong or elliptical, thick-walled, brownish yellow, pellucid; median cells of leaf sheath up to 80 μ long and 28 μ wide, thin-walled, large, rectangular to rectangular-hexagonal, hyaline. Synoicous, some plants male and female and some only male; paraphyses thread-like; calyptra reaching almost to middle of urn; seta short, 12–18 mm. long, reddish-brown; capsule erect, straight, narrowly elliptical to cylindrical, leathery brown, slightly shiny, urn 1.6–2.4 mm. long by 500 μ broad, *outer cells* about *as 4 is to 1*, inner wall with ridges of single rows of cells; neck distinct; annulus of 3–4 rows of large cells, separating, breaking to pieces as it rolls up; *lid* short, about *1/4–1/3 the length* of *urn*, conic to obliquely beaked, crenulate-margined; peristome *teeth* short, about 400–500 μ long, *making a single turn* to the left, nearer in pairs, purplish; basal membrane of peristome about 70 μ high, of 3–4 rows of cells, red; cell walls convex, projecting above the annulus; *spores* small about 14–18 μ, yellowish-green, *finely granular*, mature in early fall. Type locality, European.

ILLUSTRATIONS:—Limpr. Laubm. **1**: 636. *f. 179;* Bry. Eur. *pl. 138;* Braithw. Brit. Moss Fl. **1**: *pl. 30E;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 24B;* Broth. Laubm. Fenn. *f. 28Q–T; Pl. 99.*

EXSICCATI:—Macoun, Can. Musci 2024, 72 in part, 185; Drumm. Musc. Am. 136; Williams, N. Am. Mosses 224; Husnot, Musci Galliae 708.

Examined:—F. A. McFadden, *8095* Mar. 23, 1931; Macoun, 334, Aug. 16, 1874, and North Hastings, Ont., Canada, 47–July 1891.

On earth and clay banks. Greenland; Rocky Mts.; Montana; British Columbia; Alaska; also Scotland, Denmark, Sweden, Siberia.

The only specimen seen of *Aloina macrorhyncha*, which was apparently of the type collection, proved to be somewhat smaller but otherwise not differing from *A. brevirostris*. In some specimens of *A. brevirostris* examined, the lid was found to be ½ the length of the urn. In European specimens the leaves and capsules are shorter, and lid conic.

2. ALOINA RIGIDA (Hedw. ex p. Schultz) Kindb. l. c. 137. 1883.

Barbula rigida Hedw. Spec. Musc. 115. 1801.
Tortula enervis Hook. & Grev. Edinb. Jour. Sci. **1**: 288. 1824.
Desmatodon rigidus Mitt. Musc. Ind. Orient. **1**: 38. 1859.
Tortula stellata Lindb. de Tortul. 233. 1864.
Aloina stellata Kindb. Eur. and N. Am. Bryin. 270. 1897.

Plants in clusters, short, slightly larger than *A. brevirostris*, brownish; stem about 560 μ long, simple; leaves from an erect sheathing base, somewhat patent, when dry bent in at top, 1.4–2.3 mm. long, 500–900 μ wide; lower leaves small, ovate-oblong, ferruginous; upper leaves twice as long, oblong, deep green, usually *longer* and *narrower, at* the *summit more spreading than* in *A. brevirostris;* margin involute, not bordered; apex mostly cucullate; costa broad, ½ the width of the leaf, vanishing at apex or rarely running out into a mucro or longer hair; upper surface of limb covered with photosynthetic filaments 2–5 cells high; median cells of leaf limb at ½ up, 11–19 μ long and about 28 μ wide, walls thick; median cells of leaf sheath about 83 μ long and 28 μ broad, thin-walled, hyaline.

Dioicous; male plants minute; bracts three, broad, ovate; paraphyses thread-like; calyptra extending almost to middle of urn, straw-colored, long-beaked; seta 1–1½ cm. long, reddish-brown; capsule erect, narrowly elliptical or ovate, shriveled when dry, larger than in *A. brevirostris* in European specimens; urn from 1.7–3 mm. long, about 500 μ wide, dirty brown, weakly shining, *cells of epidermis* about 3 : 1; *annulus broad,* of 2–3 rows of cells, *separating, rolling up spirally; lid* usually *1/2–2/3* the *length of* the *urn,* long-beaked, *straight* or *slightly curved,* persistent, margin crenulate; peristome *teeth* forming *2–3 turns of a spiral,* about 0.68–1 mm. long, reddish, longer than in *A. brevirostris;* basal membrane of peristome 47–70 μ high, yellowish, projecting over the annulus; spores 10–17 μ, smooth, yellowish green. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl. 137;* Braithw. Brit. Moss Fl **1**: *pl. 30F;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 24D; Pl. 99.*

EXSICCATI:—Husnot, Musc. Gall. 258.

Examined: J. H. Savage 27; O. D. Allen, Calif. in 1928; F. M. Reed 45; Munz 4725, Calif.; Dr. J. Mueller 185; Macoun 16; E. H. Hall 125, and Bluffs of the Platte, lat. 40°, Field Museum No. 794819; Council Bluffs, Iowa (*Shimex*) Field Museum No. 92953.

On earth. Niagara, Illinois, Rocky Mts., California; Europe.

2a. Var. PILIFERA (Bry. Eur.) Limpr. Laubm. **1**: 637. 1890.

Tortula bifrons DeNot. Sp. de Tortul. Ital. 17. 1837; Syll. Musc. Ital. 176. 1838.
Barbula rigida var. *pilifera* Bry. Eur. fasc. 13–15. 1842.
Tortula rigida var. *piligera* DeNot. Musc. Ital. **1**: 19. 1862.

Costa extending into a long hair about 84 μ long.

ILLUSTRATIONS:—Bry. Eur. *pl. 137.*

Examined: Verdugo Hills in Los Angeles County, California (McFadden 8116) 1931; Guadalupe Island (Edward Palmer 108) 1875.

On earth. California, Guadalupe Island; Europe.

No capsules were present on specimens examined.

This might be mistaken for a species of *Crossidium* but is distinguished by the much broader band of ventral and costal filaments and the incurved leaf margins.

3. ALOINA ALOIDES (Schultz) Kindb. Laubm. Schwed. u. Norw. 136. 1883.

Tortula rigida Sm. Fl. Brit. **3**: 1249. 1805. Not of Hedw. 1801.
Trichostomum aloides Koch. Mscr.; Schultz in Nov. Acta. Acad. Caes. Leop. **11**: 197. 1823.
Barbula aloides Fuernr. Flora **12**[2]: 598. 1829; Bry. Eur. fasc. **13–15**: 15. 1842.
Tortula aloides DeNot. Syll. Musc. Ital. 177. 1838.
Tortula aloides Aongstr. Nov. Acta Soc. Upsala **12**: 377. 1844.

Plants in dense patches, somewhat more vigorous than *A. rigida*, dull green to reddish-brown; stem about 920 μ long; leaves only a little standing off or patent, when dry bent or curled in, larger than in *A. rigida*, linear-lanceolate, reddish-brown; the lower ones about 800 μ long, the upper ones 2.6–3.6 mm. long and about 600 μ broad; margin involute; apex incurved and cucullate, rarely pointed; costa ⅓–½ the width of the leaf, sometimes thickened in the middle, convex at back, covered above by photosynthetic filaments 2–5 cells high; median cells of leaf limb at ½ up about 11 μ long and 28 μ wide, thick-walled and vertically compressed; median cells of sheath about 56 μ long, and 22 μ wide, thin-walled and hyaline.

Dioicous; paraphyses thread-like to almost clavate; *calyptra reaching from a little below the lid* almost *to middle of* the *urn;* seta 1–1.5 cm. long, yellowish above to reddish-brown below; capsule slightly inclined, straight to a little curved, cylindric, reddish-brown and shining, of rather thick texture, in age irregularly, longitudinally wrinkled; urn about 2.5–3 mm. long and 800 μ wide, with epidermal cells as 3 is to 1; annulus narrow, of 1–2 rows of small cells, persistent; lid ⅓–½ the length of the urn, easily deciduous, beak thick and blunt to somewhat slender, its margin crenulate; peristome teeth short, about 680 μ long, twisted once, curved in when dry, with tips pointing upwards, yellowish-red; *basal membrane* of peristome 1–3 rows of cells, *not projecting* above the *annulus*, light yellow; spores 15–27 μ in diameter, greenish-yellow, smooth. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl. 139;* Engler and Prantl, Nat. Pfl.-Fam. (Ed. 2) **10**: *f. 240;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 24E; Pl. 99.*
EXSICCATI:—Rabenhorst, Bryoth. Eur. 786; Ren. and Card. Musci Eur. Exsic. 121; Husnot, Musc. Gall. 10.
Examined: Rheinland, Germany (A. Schumacher Dec. 1929); Hessen, Darmstadt, Germany (Roth Nov. 1885); Dier Khouna, Syria (W. B. Evans, Feb. 14, 1931); Swanage, England (Mitten 1906).
On earth and clay walls. Newfoundland (Paris); also British Isles, Europe, Asia Minor, Algeria.

3a. Var. AMBIGUA (Bry. Eur.) **n. comb.**

Barbula rigida Hedw. Stirp. Crypt. **1**: 65. 1785; Brid. Bryol. Univ. **1**: 528 et 824 excl. syn. Schultz 1826. Not of Hedw. 1801.
Tortula rigida Brid. Spec. Musc. Suppl. **1**: 245. 1806. Not *Barbula rigida* Hedw. 1801.
Barbula ambigua Bry. Eur. fasc. **13–15**: 14. 1842.
Tortula ambigua Aongstr. Nov. Acta Soc. Upsala. **12**: 376. 1844.
Tortula ericaefolia Lindb. Musc. Scand. 20. 1879.
Aloina ericaefolia Kindb. l. c. 137. 1883.
Aloina ambigua (Bry. Eur.) Limpr. Laubm. **1**: 638. 1890.

Leaf apex sometimes acute; calyptra scarcely reaching the base of the lid and falling off with it; *basal membrane* of peristome about 70 μ high, composed of about 5 rows of light yellow cells, *projecting above* the *annulus*. Type locality, Scotland.

On earth and clay walls. Illinois (*E. Hall*), British Columbia (Macoun), California; also in central, west and south Europe, Norway, England, Algier, Tunis, Caucasia, Western Asia.

ILLUSTRATIONS:—Bry. Eur. *pl. 139;* Limpr. Laubm. **1**: *f. 180;* Braithw. Brit. Moss Flora **1**: *pl. 30G;* M. H. M. 161. *f. 75.*
EXSICCATI:—F. Renauld & J. Cardot, Musci Eur. Exsic. 120; W. Migula, Kryptog. Germ. Austr. 151.
Examined: France (Herbier Charrier, Apr. 17, 1932); Rheinland, Germany (Schumacher, 15/10/26) as *A. rigida;* Athens, Illinois (*E. Hall* 1862).*
No specimens of *Aloina aloides* proper from North America were seen. European specimens of both this and *A. ambigua* were examined, however. In these examinations the distinguishing characters did not hold,

*Hall's specimen has leaves 2.8–3.2 mm. long and about 0.68 mm. wide. Dioicous; calyptra lacking; capsule erect, straight, cylindric; urn 3.2 x 0.8 mm.; annulus narrow, persistent; operculum lacking; peristome teeth short, twisted once; basal membrane of about 5 rows of cells projecting above the annulus.

for the most part. The leaves were found to be the same in length; the apex blunt in both species, except in one specimen as *A. ambigua* with part of the leaves with apex acute and part with apex blunt on the same plant; costa of *A. aloides* not always thickened; the *calyptra* was not seen in either species; capsule slightly inclined to the horizontal in *A. aloides*, and usually erect in *A. ambigua;* urn the same in length; lid somewhat thick and blunt to slender-beaked, ⅓–½ the length of the urn; peristome teeth found to be the same in length; *basal membrane of* peristome of 1–3 rows of small cells, *not projecting above* the *annulus in A. aloides*, while in *A. ambigua* the basal membrane is *70 μ high*, composed of *5 rows of cells projecting above* the *annulus;* no difference was found in the size of the spores.

It is my opinion that the differences in the height of the basal membrane of the peristome, the slight inclination of the capsule, and the possible difference in the length of the calyptra are not great enough to make separate species, but that *A. ambigua* becomes a variety of *A. aloides*.

6. CROSSIDIUM Jur. Laubmfl. 127. 1882.

Barbula, section *Chloronotae* Bry. Eur. fasc. 12–15. 1842.

Plants xerophytic, calcicolous, small, in dense hoary tufts; stems sparingly branched; central strand well developed; lower leaves smaller, the upper close and much larger with longer hyaline awns; strongly concave, appressed, oblong-ovate to oblong, acuminate to emarginate; margins recurved to narrowly revolute in part; costa strong, larger above and covered with a dense growth of green cellular threads, which apparently are useful in absorbing water and in assimilation, doubtfully in reproduction, in cross section showing a ventral mass of large cells giving rise to the filaments, a dorsal group of small (stereid) cells and between these a group of small thin-walled cells; leaf cells smooth, thick walled, and oval to short-oblong or hexagonal above with little chlorophyll; the lower thin-walled, hyaline, rectangular to narrowly hexagonal, more or less collenchymatous; perichaetial leaves little different except in *C. spatulaefolium*, the inner often smaller. Dioicous or monoicous; seta long-exserted, erect; capsule oblong-elliptic to oblong-cylindric, erect and symmetric or nearly so; calyptra cucullate, large, smooth; operculum, thimble-shaped to conic with cells oblique or spirally arranged; peristome as in *Barbula* or less developed and more irregular from a low basal membrane. Type species, *C. squamigerum*.

Bartram and Holzinger (Bryol. **26:** 68. 1923) reached the following conclusions after a careful study of the genus: *C. chloronotos* (Brid. in part) Limpr. is not found in North America. *C. Henrici* (*Rau) Kindb. is a *Pterygoneurum*.

A great deal of confusion has been caused by the fact that Bridel included both *C. squamigerum* and *C. chloronotos* under his *Barbula chloronotos*. Also the leaves of *C. squamigerum* and *C. griseum* are so much alike that they have often been confused.

Husnot, Musc. Gall. 66B as *Barbula membranifolia* Hook. is *C. griseum*. Rabenhorst's Bryotheca Eur. 672 as *Barbula chloronotos* is *C. squamigerum* and his 1272 as *Barbula chloronotos* is a *Tortula*, at least in two collections studied.

Key.

1.	Leaf border near apex colorless with cells elongate	2.
	Leaf cells of border near apex not elongated or colorless	3.
2.	Costal filaments thick-walled throughout; elongate cells of beak of operculum arranged in a spiral of more than one turn; peristome teeth long and slender twisted more than one turn	*1. squamigerum.*
	Only the upper 1 or 2 cells of costal filaments thick-walled; cells of operculum merely oblique; peristome shorter, only slightly twisted, the teeth more or less connate	*2. griseum.*
3.	Leaf cells strongly papillose	5.
	Leaf cells smooth, rarely with faint papillae near the apex of some leaves	4.
4.	Leaves entire at apex; hyaline hair point often longer than the blade	*3. desertorum.*
	Leaves erose dentate at the blunt or emarginate apex, hair point usually shorter than the blade	*4. erosum.*
5.	Perichaetial leaves not or scarcely spatulate	*5. aberrans.*
	Perichaetial leaves strongly spatulate	*6. spatulaefolium.*

* Not Ren.

1. Crossidium squamigerum (Viv.) Jur. l. c.

Barbula squamigera Viv. Ann. Bot. 1²: 191. 1804.
Tortula chloronotos Brid. Sp. Musc. 1: 253. 1806. Not of later authors.
Tortula membranifolia Hook. Musc. Exot. 1: *pl. 26.* 1818.
Desmatodon chloronotos Mitt. Musc. Ind. Orient. 38. 1859.

Plants in dense tufts, gray-green, up to 2 mm. high; leaves erect-spreading, appressed when dry, concave, ± 1 mm. long, ovate-oblong, acuminate, colorless on the margins near the apex; margins plane or slightly reflexed, serrate near apex; costa rough at back near the apex, extending into a hyaline, somewhat rough hair point equaling or exceeding the length of the blade; costal filaments with 3–4 of the end cells thick-walled, the terminal cells elongate-conic with two or more large papillae; basal leaf cells short-rectangular, smaller near the margin, the median rounded-oval, thick-walled with lumen about 15 μ in longest dimension; marginal cells near apex colorless, elongate-oblong to linear. Monoicous; antheridial buds at base of perichaetium or in a short offshoot; seta 1–2.4 mm. long, yellowish, turning darker with age; capsule erect and symmetric or nearly so, urn oblong-cylindric, slightly broader below, up to 3 mm. long; operculum conic-rostrate, ⅓–½ the length of the urn, cells of beak elongate and spirally arranged for about two turns; annulus of small cells; peristome teeth from a basal membrane up to 90 μ high, bifid into long filiform prongs, papillose and about twice twisted; spores 14–20 μ, mature in early spring. Type locality, European.

Illustrations:—Bry. Eur. *pl. 140; Pl. 100.*
Exsiccati:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 95b, (Ed. 2) 126.
Apparently calcicolous; California and Arizona (*Bigelow*); Rocky Mountains (*Hall*).

2. Crossidium griseum (Jur.) Jur. Laubmfl. 128. 1882.

Desmatodon griseus Jur. in Verh. d. Zool-bot. Ges. Wien **1864:** 399. 1864.
Barbula membranifolia var. *grisea* Vent. in Comment d. Fauna, Flora etc. Venezia no. 3. 1868.
Barbula grisea Boulay, Musc. d. l. France 1: 434. 1884.
Crossidium succulentum Holz. & Bartr. Bryol. **26:** 69. 1923.

Closely cespitose in dense gray-green cushions, 4–6 mm. high, tender and succulent in texture when moist, hardly so when moistened after drying; leaves erect-spreading, loosely imbricate, blade up to 2 mm. long, oblong-ovate, usually bluntly rounded and subcucullate at apex; margins plane or slightly recurved, entire below, sharply serrate at the colorless apex; nearly or quite as long as the blade; leaf cells smooth, short-rectangular at base, becoming smaller above, irregularly oblong and transversely elongated above, in the hyaline margin at apex becoming very thick-walled, often with linear lumen 15–25 μ long; costa strong, excurrent into a hyaline, faintly toothed hair wider above often with sharp papillae at back near apex and covered with a dense opaque mass of 3–5 celled filaments occupying more than ⅔ of the upper surface of the leaf in the concave spoon-shaped hollow of the leaf, with apical cell elongate, conic, thick-walled and crowned with 1–3 large horn-like papillae, the other filament cells are short-ovoid and thin-walled, chlorophyllose. Autoicous; perichaetial leaves little differentiated, the inner apparently narrower with a larger area of thin-walled rectangular basal cells; antheridia below the base of the perichaetium, surrounded by one or two small leaves little longer than the antheridia and club-shaped paraphyses; seta ± 1 cm. in length, orange; capsule erect and symmetric, oblong-cylindric, urn ± 2 mm. long; operculum conic-rostrate, not over ⅓ the length of the urn, the elongate cells of the beak oblique but scarcely spirally arranged; annulus inconspicuous; peristome teeth from a narrow basal membrane, up to 0.24 mm. long, red-brown, irregularly divided and connate, strongly papillose with narrow high papillae; spores 10–12 μ, mature in early spring. Type locality, Austria.

Illustrations:—Bryol. **26.** *pl. 5;* Limpr. Laubm. 1: *f. 181: Pl. 99.*
Exsiccati:—Bartr. Mosses S. Arizona, 65; Holz. Musc. Acro. Bor. Am. 484, 631; Husnot, Musc. Gall. 66B, as *Barbula membranifolia.*
The more obtuse leaves and smooth costa by which Bartram and Limpricht would distinguish this from the preceding do not seem to hold, but the differences cited in the key are pretty definite. The available European material has been scanty but a careful comparison of the available material of *C. succulentum* and *C. griseum* fail to show any differences beyond the range of normal variation. Mr. Bartram agrees with this decision.
On dry shaded banks and rock clefts; Arizona (*Bartram*), California (*Coville & Funston; Bigelow*).

3. Crossidium desertorum Holz. & Bartr. Bryol. **26**: 72. *pl. 6.* 1923.

Plants closely cespitose in thin wide olive-green mats, up to 3 mm. high; leaves erect and closely imbricate when dry, spreading when moist, usually 0.75–1 mm. long, concave, oblong-ligulate, obtuse; margins entire, narrowly revolute to below the middle, terminated by an almost smooth hyaline hair 1 mm. or more in length and usually much exceeding the leaf in length; costa weak below, becoming wider and stronger above and bearing in the upper ½ a dense mass of filaments covering more than ½ the upper surface of the lamina, with apical cells conical and terminating in 1–2 weak papillae; leaf cells smooth, hyaline and short rectangular at base, becoming rounded-quadrate to transversely oval in the leaf middle and irregularly rhombic oval, 8–10 μ in diameter. Dioicous; antheridial buds terminal on plants more slender than the archegonial; sporophytes much like those of *C. chloronotos* (Brid.) Limpr. except that the peristome is much shorter and less twisted from a rather broader basal membrane. Also the perichaetial leaves are more rounded-obtuse. Type locality, high shaded banks along dry washes near Tucson, Pima Co., Arizona (*Bartram* no. 547, Feb. 5, 1923).

Illustrations:—Bryol. l. c.; *Pl. 101.*

Exsiccati:—Holz. Musc. Acro. Bor. Am. 483; Bartr. Mosses S. Arizona 67.

Nearest the European *C. chloronotos*, from which it differs in the narrower ligulate outline of the leaves, the broader filamentose area covering much more of the leaf surface and the basal cells shortly rectangular and hyaline instead of enlarged and yellowish. Description adapted with few changes from the original description. Mr. Bartram has collected this species in several other neighboring localities in Arizona.

Much of the material of *C. desertorum* available is depauperate and poorly developed, which accounts for the difference in the basal cells, which is not constant. I have seen European *C. chloronotos* with the costal filaments covering fully ½ the width of the upper leaf. The leaf margins of *chloronotos* are much more recurved than is shown in Bry. Eur. *pl. 141.* The European exsiccati are badly mixed but Bauer, Musc. Eur. et Amer. Exsicc. 2112a and Husnot, Musc. Gall. 453, are true *chloronotos.*

4. Crossidium erosum Holz. & Bartr. Bryol. **27**: 3. 1924.

"Dioicous. Caespitose in pale green mats, older parts brown, about 2 mm. high, radiculose at base. Leaves erect and incurved or very slightly contorted when dry, spreading when moist, about 1.5 mm. long, concave, ovate, obtuse or emarginate, margins entire and reflexed in the middle portion, plane and erose-dentate at apex, terminated by an almost smooth hyaline hair which is normally shorter than the leaf or even reduced to a colored mucro in the emarginate forms. Leaf cells hyaline and short rectangular at base, round-quadrate above, 10–12 μ in diameter, mostly smooth on both sides. Costa about 60 μ wide at the base, covered in the upper half with 3- to 5-celled chlorophyllose filaments, the terminal cell of which is conical with one or two weak apical papillae. Male plants not seen. Pedicel reddish yellow, flexuous, lightly twisted to the left when dry, about 10–15 mm. long. Capsule cylindric, brown, 1.5 mm. long x 4 mm. wide. Operculum conic, blunt, slightly curved, 7 mm. long with the cells arranged in spiral lines. Calyptra cucullate, covering about one-third of the capsule. Annulus narrow, of two or three rows of small pellucid cells. Peristome teeth 32, linear, pale yellow, about 0.4 mm. long, papillose, twisted in one spiral turn from a basal membrane extending 50–65 μ above the mouth of the capsule. Spores ovoid, smooth, 8–10 μ in diameter.

"Type: Mesa north of Rillito Creek, Pima County, Arizona. E. B. Bartram, No. 11, January 16, 1920."

Illustrations:—Bryol. l. c. *pl. 1; Pl. 101.*

Exsiccati:—Holz. Musc. Acro. Bor. Am. 504, 629; Bartram, Mosses S. Arizona 120, 121. Both have some papillose leaves.

"Distinguished from *C. desertorum* by the shorter hair-points and narrower filamentose area and from *C. chloronotos*, to which it is evidently closely allied, by the rounded erose-dentate apical leaf margins, and also by the shorter basal cells of the leaves.

"It is to be noted that the inner perichaetial leaves of the species are narrowly lanceolate, with a short hair-point or none, and the costa in some, ceases a distance below the apex, or is absent. Also, the costal filaments on them are few or disappear entirely."

Quotations from the original descriptions.

The operculum may be 1 mm. or more in length. The length of the basal leaf cells varies from 30–60 μ in both *C. chloronotos* and *C. erosum* and it is difficult to see any constant difference between the species in this respect. In both species a few papillae may be seen on the upper part of some leaves.

5. CROSSIDIUM AERIANS Holz. & Bartr. Bryol. 27: 4. pl. 3. 1924.

"Arizona." Caespitose in interwoven green mats, older plants light brown, radicose at base. Stems often growing from the leaf axils of old stems, and apparently reproduced from axillary gemmiform threads, leaves erect and spirally contorted when dry, spreading when moist, to 1.4 mm. long, hair-point smooth, up to 1 mm. long; perichaetial leaves oval, usually widest at base, the inner usually retuse at apex and without hair point, the 2–3 others short-apiculate by the more or less excurrent costa"; all rounded at apex, margin entire and broadly reflexed; leaf cells at base ayaline, thin-walled, short-rectangular, about 2 μ, in the median portion quadrate-hexagonal to transversely rectangular, towards the apex round-hexagonal, 10–15 μ in diameter, somewhat mamillose on the dorsal face, costa about 80 μ wide at base, bearing on the ventral surface in the upper ½ scattered clusters of short filaments here 1 exceeding the width of the costa in length and often consisting of only a single cell bearing several knob-like small papillae. Setae 6–12 mm. long, erect; capsule oblong-cylindric, about 2 mm. long; operculum 0.8–1 mm. long with spirally arranged cells; peristome about 0.8 mm. long, of 32 slender papillose filaments from a basal membrane about 60 μ wide, twisted about one turn to the left; spores about 10 μ in diameter, mature in winter. Type locality, shaded ground among boulders in Soldier's Canyon, Santa Catalina Mts., Pima Co., Arizona, Jan. 27, 1923 (*Barnum*, no. 484).

ILLUSTRATIONS.—Bryol. l. c. & *Pl.* 102.
EXSICCATI.—Bartr., Mosses S. Arizona no. 122.
Also from California (Bigelow) in the James herbarium as *C. chlorinum*.
Under the microscope the somewhat very small area covered by the costal filaments is strikingly different from the preceding species. One must look carefully to see the mamillae in profile as they are quite inconspicuous. The description is adapted from the original.

6. CROSSIDIUM SPATULAEFOLIUM Holz. & Bartr. Bryol. 27: 6. pl. 3. 1923.

Plants with the general appearance of *C. aberrans*, but apparently more robust, up to 3 mm. high. Leaves up to 1.5 mm. long, 0.2–0.3 mm. wide; perichaetial leaves up to 1.4 mm. long, rounded or shortly mucronate at apex, with the costa in some cases ending below the apex, the inner spatulate from a narrow elongate base of pellucid rectangular cells, 16–25 μ wide and 1–9 : 1; leaf cells of upper leaf in general more sharply papillose and mamillose than in *C. aberrans* and the costa often papillose at back near the apex; peristome also longer and more twisted. Type locality "On rocks near Nogales, Arizona" (Lieberg, no. 1030, Feb. 1906), in the herbarium of the New York Botanical Garden as *C. chlorinum*.

ILLUSTRATIONS.—Bryol. l. c.; *Pl.* 102.
EXSICCATI.—Holz. Musc. Acro. Bor. Am. 630.
Evidently not as distinct as the authors thought for there are spatulate leaves in Barttram's Mosses of Southern Arizona no. 122. Perhaps better considered as a variety of *C. aberrans*.

7. HUSNOTIELLA Card. Rev. Bryol. 36: 71. 1909.

Plants small, caespitose; stems short, erect; leaves ovate to shortly lingulate, rounded at apex; margins entire, strongly revolute; costa strong, vanishing below the apex, often upwardly thickened, in cross section with ventral guides and a dorsal stereid band only; upper leaf cells quadrate or rounded-hexagonal, more or less papillose to nearly smooth; seta erect, rather long; capsules subcylindric; operculum conic-rostrate; annulus present; peristome very rudimentary or lacking; calyptra cucullate. Type species, *H. revoluta*. (Description translated from the original.)

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*: Note.—The inflorescence in this and the following species is apparently dioicous. The dissection of a number of plants failed to reveal antheridia in archegonial rosettes. And, in only three of such rosettes were antheridial buds discovered. These grew from one of the inner perichaetial leaves at the base of the seta. They consisted of two perigonial leaves, one with short costa, the other ecostate and rounded at apex. Two of these contained only male gametes, which were oval-shaped as they are in this genus. The third bud contained in addition two young antheridia. We surmise that the scarcity of antheridial buds is due to the very early collection of these plants in January. Under the circumstances we can not with certainty ascribe dioicous inflorescence to them."

KEY

1. Leaves oblong-lanceolate to ovate-lanceolate; costa not or indistinctly spurred..... 3.
   Leaves broadly ovate to lingulate; costa laterally spurred above..... 2.
2. Leaves broadly ovate-lingulate, rounded at apex, erect-imbricate when dry..... *1. revoluta.*
   Leaves lingulate, more apiculate, crisped when dry..... *1a.* var. *Palmeri.*
3. Leaves ovate-oblong; perichaetial leaves lingulate, broadly obtuse; costa ending well below the apex..... *3. Pringlei.*
   Leaves linear-lanceolate to oblong-lanceolate; perichaetial leaves little different..... *2. torquescens.*

1. HUSNOTIELLA REVOLUTA Card. l. c.

Didymodon revolutus Williams, Bryol. **16:** 25. 1913.

Plants densely cespitose; stems short, up to 6 mm., erect; leaves contorted-appressed when dry, widely spreading to almost reflexed when moist, ovate to ovate-lingulate, obtuse and rounded at apex; margins entire, strongly revolute except at base; costa strong, irregularly wider and spurred above and often sublamellose ventrally, ending abruptly below the apex, in cross section with large ventral cells and a single dorsal stereid band; upper leaf cells small, 7–10 μ, obscure, rounded, more or less papillose or mamillose; lower cells larger, nearly hyaline, smooth, quadrate to short-rectangular; perichaetial leaves subsheathing at base, longer and more loosely areolate, otherwise little different. Apparently dioicous as no antheridial buds were found; seta reddish, 6–8 mm. long; capsule erect, subcylindric; operculum conic-rostrate, $\frac{1}{3}$–$\frac{1}{2}$ the length of the urn; annulus present, dehiscent in fragments; peristome lacking or consisting of a short delicate, irregular membrane; calyptra cucullate, covering $\frac{1}{2}$ of the capsule. Type locality, Mexico. *Pl. 119.*

EXSICCATI:—Bartram, Mosses S. Arizona 127, as *H. torquescens.*

The plants appear to grow in dense thin mats with the lower portion of the stems imbedded in lime accretions from the soil or rocks.

On masonry walls and alkaline soil Fort Davis and Brownsville, Texas (*Orcutt*); Arizona (*Bartram*, nos. 119, 1189, 1650); near Kenwood, Calif. (*Koch* and *Baker* 5-5-1938). Frequent in the elevated districts of northern and central Mexico.

1a. Var. PALMERI (Card.)* Thér. Smithosian Misc. **85**[4]: 7. 1931.

Husnotiella Palmeri Card. Rev. Bryol. **37:** 121. 1910.

Leaves narrower, linear-lingulate, sometimes acute or apiculate. Type locality, Durango, Mexico (*Palmer*, 761). Probably only an occasional variation, as the type was found with the variety in Oklahoma (*Little*) and elsewhere.

2. HUSNOTIELLA TORQUESCENS (Card.) Bartr. Bryol. **29:** 45. 1926.

Didymodon torquescens Card. Rev. Bryol. **36:** 83. 1909.

Plants cespitose, bright green above, paler below, 2–10 mm. high; leaves somewhat clustered at the top of the stem, erect-spreading when moist, spirally contorted when dry, narrowly oblong-lanceolate, ± 1 mm. long, obtuse, acute, or apiculate; margins entire, strongly revolute except at base; costa strong, percurrent or nearly so, in cross section same as *H. revoluta;* upper leaf cells rounded, unistratose, papillose with broad low papillae; basal quadrate, smooth. Dioicous; seta 4–7 mm. long; capsule erect, oblong-subcylindric, operculum conic-rostrate; annulus distinct, narrow, deciduous; peristome rudimentary, teeth very short, fugacious. Type locality, State of Michoacan, Mexico. Also two localities in Arizona (*Bartram*); Texas, (*Orcutt*, 7090). *Pl. 119.*

Both this and the preceding appear like a thin green crust over the substratum.

3. HUSNOTIELLA PRINGLEI (E. G. Britton) **n. comb.**

Dactylhymenium Pringlei (E. G. Britton, Ms.) Card. Rev. Bryol. **36:** 72. 1909.
Gyroweisia Pringlei E. G. Britton, Ms., according to Cardot, l. c.

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* See. Bryol. **16:** 25; **29:** 44; **32:** 7.

Plants densely cespitose, 2–3 mm. high; stems slender, erect, loosely foliate; leaves erect-incurved when dry, widely spreading when moist; ovate-lanceolate, broadly and obtusely acuminate, up to 1 mm. long; margins entire, strongly revolute except at extreme base and apex; costa papillose at back, ending well below apex in most leaves, in cross section in some portions with nearly uniform cells, in others with large ventral cells and a single dorsal stereid band; upper leaf cells small, 7–10 μ, rounded-quadrate to irregular, smaller near the margin, strongly papillose, cells near the base larger, short-rectangular, less papillose; perichaetial leaves oblong-lingulate. Antheridia not found; sporophytes often lateral; seta straight, erect, $\pm$ 1 mm. long; capsule oblong to subcylindric, urn 1 mm. or more in length, erect and symmetric; operculum conic-rostrate, more than ½ the length of the urn; peristome of a narrow membrane, granular and somewhat perforate; annulus narrow, of small cells, persistent. Type locality, State of Chihuahua, Mexico. *Pl. 119.*

Exsiccati:—Bartram, Mosses S. Arizona, 73, 112; Holz. Musc. Acro. Bor. Am. 632. Also in New Mexico (*Rusby*); Santa Catalina Island (*Kingman*). Oklahoma, in quantity (Sharp

8. DESMATODON Brid. Musc. Recent. Suppl. **4**: 86. 1819.

Plaubelia Brid. Bryol. Univ. **1**: 522. 1826.

Mostly plants of high altitudes or latitudes, small or medium sized, usually growing in rather compact cushions on soil; stems usually with central strand, simple or somewhat branching; leaves usually close, erect-appressed and somewhat incurved or contorted when dry, ovate, oblong, oblong-lanceolate or rarely somewhat spatulate, broadly acute to obtuse, entire or slightly serrulate near the apex; margins plane, recurved or broadly incurved; costa strong, vanishing below the apex to slightly excurrent, more rarely extending into a short nearly smooth hair-point, in cross section showing 2–4 median guides with one or two rows of somewhat smaller large cells ventrally, a dorsal stereid band with dorsal layer of cells differentiated; upper leaf cells small, quadrate to hexagonal or irregular, rarely elongated, mostly distinct but thick-walled and mamillose to papillose, less frequently densely papillose and obscure; lower leaf cells smooth, pale, larger and elongate; perichaetial leaves little different as a rule. Monoicous or dioicous; seta elongate, usually twisted; capsule oblong to cylindric, usually erect and symmetric but in some cases unsymmetric, curved and cernuous (*D. cernuus*); annulus usually present, often persistent and inconspicuous; stomata few, mostly near the capsule base; peristome papillose, jointed, the 16 teeth (often poorly developed in *D. obtusifolius*) from a narrow basal membrane, mostly divided to near the base into 2–3 slender prongs, often irregular and irregularly anastomosing; calyptra large, cucullate. Type species, *D. latifolius.*

Acknowledgments are freely made to Williams' monograph, Bull. Torr. Club **46**: 207–220. 1919. There *D. systilioides* R. & C. from Newfoundland is assigned to *Pottia.*

The peristomes are much like those of *Didymodon* but not the structure of the costa which is distinctly Pottioid.

Key.

1.	Leaves distinctly bordered to near apex by a thickened band of narrow cells; capsules cernuous or pendent	2.
	Leaves bordered by a band of lighter cells little different or slightly more elongate	11.
	Leaves not bordered; capsules erect and symmetric or nearly so	3.
2.	Leaves strongly papillose; capsules strongly inclined to pendulous; cells of operculum oblique; peristome teeth twisted one turn	*13. Laureri.*
	Leaves smooth to lightly papillose; capsules curved and cernuous; cells of operculum not oblique; peristome teeth not twisted	12. *cernuus.*
3.	Cells of upper portion of leaf papillose with variously shaped papillae	4.
	Cells of upper leaf not papillose but often more or less mamillose	12.
4.	Upper leaves at least hair-pointed or awned by the excurrent costa	5.
	Upper leaves not awned or hair-pointed; costa sometimes barely excurrent	8.
5.	Blade of upper leaves 1.5 mm. long or even less	*3. Guepini.*
	Blade of upper leaves 2–3 mm. long	6.
6.	Monoicous; upper leaf cells up to 12–18 μ; Rocky Mts. and subarctic	7.
	Dioicous; upper leaf cells up to 10 μ; range from Pennsylvania to Alabama and Texas.	*5. plinthobius.*
7.	Leaves spatulate to oblong	*1. latifolius.*
	Leaves gradually tapering from below the middle to an acute apex	*2. suberectus.*

8. Leaves ovate-lanceolate to oblong-lanceolate; operculum long-rostrate, ⅔ the length of urn ..... 10.
Leaves oblong-lingulate to oblong or oblong-ovate; operculum short-rostrate ..... 9.
9. Upper leaf cells up to 8 μ ..... *7. obtusifolius.*
Upper leaf cells about 18 μ ..... *1a.* var. *muticus.*
10. Leaves rounded-obtuse to apiculate; costa scarcely percurrent ..... *8. Hendersoni.*
Leaves acute; costa percurrent to excurrent ..... *9. convolutus.*
11. Leaves obtuse, rounded or abruptly apiculate ..... *10. coloradensis.*
Leaves acute ..... *6. Porteri.*
12. Leaf margins strongly involute; costa ending in the apex or below it ..... *11. Sprengelii.*
Leaf margins plane except near base; costa excurrent into a hair-point ..... *4. systilius.*

T. barbula (Schwaegr). MF II 271 (Florida)

Sterile plants of *Pottia Randii* are hard to distinguish from *D. cernuus*. In general the leaves are less papillose and the costa less excurrent. The entire lack of peristome in *P. Randii* and the well developed peristome in *D. cernuus* is a very marked distinction with no intergradations known at present. The very large (35–59 μ) spores found in each are strikingly similar. The late John M. Holzinger considered them as conspecific.

1. DESMATODON LATIFOLIUS (Hedw.) Brid. Musc. Recent. Suppl. **4**: 86. 1819.

Dicranum latifolium Hedw. Stirp. Crypt. **1**: 89. *pl. 33.* 1789; Sp. Musc. 140. 1801.
Didymodon pilifer Wahlenb. Gl. Suec. (Ed. 2) **1**: 754. 1826.
Trichostomum piliferum Hueben. Musc. Germ. 293. 1833 (except synonyms).
Trichostomum latifolium Lindb. De Tort. 224. 1864.
Tortula latifolia Lindb. Musc. Scand. 20. 1879.
Barbula latifolia Kindb. Eur. & N. Am. Bryin. **2**: 252. 1897.

Plants tufted, green to brownish, reddish tomentose within; stems from a few millimeters up to (occasionally) 2 mm. long; upper leaves larger, oblong to somewhat spatulate, somewhat contorted when dry, 2.5–3 mm. long, broadly acute to nearly obtuse, concave; margins more or less revolute on one or both sides, papillose and entire; costa papillose on both faces above, nearly percurrent to excurrent into an almost smooth hair-point, in cross section showing median guides with a row of ventral cells nearly as large, a dorsal stereid band bordered by a larger row of dorsal cells; upper leaf cells quadrate-hexagonal to subrectangular up to 20 μ in longest dimension but usually less, obscured by many variously shaped papillae on both sides, some c-shaped; basal larger, smooth, rectangular to elongate-hexagonal, narrower near the margin; perichaetial leaves little different. Autoicous; antheridial buds a little below the perichaetium; seta erect, 1–2 cm. long, yellow, darker with age; capsule erect and symmetric or nearly so, oblong-cylindric, urn 1–2 mm. long, brown, chestnut colored when old; annulus of small cells, more or less persistent; peristome densely papillose, from a basal membrane extending above the annulus, the 16 teeth mostly split to near the base into two slender forks, sometimes more irregularly divided and connate at the joints; operculum obliquely rostrate, ½–⅓ the length of the urn, the elongated upper cells in erect rows; calyptra cucullate, descending well towards the capsule base; spores papillose, 18–24 x 30 μ, mature in summer. Type locality, Sweden or Lapland.

ILLUSTRATIONS:—Hedw. l. c.; Bry. Eur. *pl. 129; Pl. 103, 104.*
EXSICCATI:—Aust. Musc. Appal. 123; Bartram, Mosses of Southern Arizona 151. Macoun, Can. Musci 69.

Subarctic or subalpine; Greenland to Unalaska; south to Gaspé, California, Arizona and New Mexico; common in the Rocky Mountains.

1a. Var. MUTICUS Brid. Sp. Musc. **1**: 207. 1806.

var. *glacialis* (Funck.) Schimp. Syn. (Ed. 1) 157. 1860.

Plants usually taller; upper leaves oblong-ovate, obtuse or apiculate; margins less revolute, costa not percurrent. Colorado and probably elsewhere. Similar leaves are often found on the lower part of typical plants. Bry. Eur. *pl. 130; Pl. 104.*

2. DESMATODON SUBERECTUS (Hook.) Limpr. Laubm. **1**: 651. 1889.

Tortula suberecta Hook. in Drumm. Musc. Am. 145. 1828.
Desmatodon obliquus Bry. Eur. fasc. 18–20. *pl. 136.* 1843.

Plants tufted; stems branching, 5–10 mm. tall; leaves broadly ovate-lanceolate, the upper larger, about 2–3 mm. long by less than 1 mm. wide, gradually tapering from about the middle to a slenderly acute or acuminate apex, terminated by a nearly smooth hair-point, rarely over 0.25 mm. long; margins papillose, recurved most of their length; costa stout, excurrent into the hair-point, in cross section as illustrated, papillose on both sides in upper leaf; upper leaf cells quadrate to hexagonal, 12–15 μ in diameter, obscure with small, variously shaped papillae on both sides; lower cells smooth, pale, mostly rectangular or elongate-hexagonal; perichaetial leaves scarcely different. Paroicous, with antheridia in a cluster just below the archegonia; seta erect, up to 18 mm. long; calyptra extending about ½ the way down the capsule; capsule oblong-cylindric, symmetric to slightly arcuate, urn about 2 mm. long; operculum long-conic, the upper cells elongate and very oblique; annulus inconspicuous, of small cells, persistent; peristome teeth from a basal membrane 0.05–0.07 mm. high, divided from near the base into two or three slender papillose forks, which are often more or less united and twisted about ½ turn; spores rough, 18–24 μ, mature in midsummer. Type locality, Rocky Mts. of British America.

EXSICCATI:—Drumm. l. c.
ILLUSTRATIONS:—Bry. Eur. l. c.; Braithw. Brit. Moss. Fl. **1**: *pl. 41E;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 24G; Pl. 105.*
On calcareous substratum; Greenland, Beechey Id., Arctic America, Canadian and Colorado (Longs Peak) Rockies; very rare.
Drummonds 145, well illustrated by the Bry. Eur. plate seems clearly distinct from *D. latifolius* by the narrowly acuminate, gradually tapering leaves, smaller leaf cells and twisted peristome. A careful study of the rather scanty American and European material finds these differences intergrading to the extent that some plants are decidedly intermediate. This should be regarded as a subspecies of the much more frequent *D. latifolius* and *D. Guepini* as a reduced subspecies of the same.

3. DESMATODON GUEPINI Bry. Eur. fasc. 18–20. *pl. 133.* 1843.

Trichostomum Guepini C. Muell. Syn. **1**: 590. 1849.
Barbula Guepini Schimp. Syn. (Ed. 2) 197. 1876.
Tortula Guepini Broth. in Engler & Prantl, Nat. Pflanzenf. 1^3: 430. 1902.

A diminutive lowland plant much like *D. latifolius;* smaller in size, up to 3 mm. high; larger upper leaves only 1–1.5 mm. long; marginal cells usually a little less papillose than the median in the upper part of the leaf and sometimes more yellowish, the upper median 14–16 μ; basal membrane of the peristome usually a little wider, forks of teeth narrower and longer; spores nearly smooth, up to 16 μ; calyptra covering about ½ of the capsule. Type locality, France. Known from France; California and New Mexico only.

ILLUSTRATIONS:—Bry. Eur. l. c.; Husnot, Musc. Gall. *pl. 26; Pl. 103, 106.*
In *D. latifolius* the marginal cells show numerous conspicuous papillae on most leaves; in *D. Guepini* these cells are usually smooth, but not always.
D. latifolius, D. suberectus and *D. Guepini* are so close to each other in characters that they are not easy to distinguish in a description. Had they not been accepted by so many European authors, one would hesitate to hold them distinct.

4. DESMATODON SYSTYLIUS Bry. Eur. fasc. 31. Suppl. *pl. 131.* 1846. (See Williams l. c.)

Anacalypta latifolia var. *pilifera* Hook. in Drumm. Musc. Am. 70. 1828.

Much like *D. latifolius;* leaves broader, shorter and broadly ovate, not papillose, but cells more or less mamillose; margins plane above, hair-point averaging longer; operculum often remaining attached to the columella after dehiscence; spores larger, 20–32 μ, mature in midsummer. Type locality, Norway.

EXSICCATI:—Drumm. l. c.
ILLUSTRATIONS:—Bry. Eur. l. c.; Pl. *103, 106.*
A rare alpine moss growing on humus; Greenland, Newfoundland, St. Paul Island, Canadian Rockies; Mt. Dana, California.

5. DESMATODON PLINTHOBIUS Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 94. 1856.

Desmatodon neomexicanus Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 95. 1856.

Plants densely cespitose; stems more or less branching, 3–4 mm. or more in length; leaves incurved-imbricate and somewhat contorted when dry, erect-spreading when moist, oblong-lanceolate to oblong-

lingulate, the upper at least twice as long as the lower, blade up to 2.5 mm. long, mostly obtuse, more rarely acute, sometimes almost emarginate; margins entire, for the most part strongly revolute from near the apex to below the middle; costa excurrent into a smooth hair-point often as long as the leaf blade, papillose on the back above, in cross section with about 4 guide cells with one or two rows of cells nearly as large on the ventral surface, a dorsal stereid band with outer cells little different; upper leaf cells obscure, subquadrate, about 8 μ wide, strongly papillose on both sides, with many C-shaped papillae among the others; lower cells rectangular, smooth, pale up to 16 x 40 μ; perichaetial leaves little different. Usually dioicous; antheridial buds terminal to lateral by innovations just below the summit; seta erect, 6–12 mm. long; capsule oblong to cylindric, erect and symmetric or nearly so, *more or less apparently contracted below the mouth* even before dehiscence, urn up to 3 mm. long; calyptra cucullate, long-rostrate, covering about ½ the urn; operculum long-conic to rostrate, occasionally nearly ½ the length of the urn, with 2–3 rows of basal cells isodiametric, the upper elongate and somewhat oblique; *annulus large, compound, persistent;* peristome teeth, densely papillose, very irregular, more or less divided and perforate, varying greatly in length, up to 175 μ, usually much shorter, usually from a short basal membrane, sometimes divided into two nearly equal forks; spores smooth, 8–10 μ, mature in spring. Type locality, Charleston, S. Carolina.

Illustrations:—Sull. Icones Musc. *pl. 30;* M. H. M. *f. 78; Pl. 103.*
Exsiccati:—Sull. & Lesq. l. c. and (Ed. 2) 123; Aust. Musc. Appal. 493. Holzinger's 233 & 233b are something else.
Walls, pavements, limestone rocks and calcareous soil; Pennsylvania to Illinois; south to Georgia, Alabama, Louisiana and Texas.
The small leaf cells, the large persistent annulus and the constriction below the capsule mouth will distinguish this from most similar species.

6. Desmatodon Porteri James, in Aust. Musc. Appal. 123. 1870.

Barbula Egelingii Schleiph. Flora, **70:** 222. 1887.
Barbula subcarnifolia C. M. & Kindb., in Macoun, Cat. Can. Pl. **6:** 52. 1892.

Plants usually in compact tufts; stems 1–3 mm. long; leaves somewhat contorted and incurved when dry, spreading when moist, the upper up to 2 mm. long, oblong- to ovate-lanceolate, acute, often apiculate with one or two clear smooth cells; margins plane, *entire, bordered with a band of 2–3 rows of more elongated cells which are lighter colored and less densely papillose,* scarcely evident in young leaves; costa stout, nearly or quite percurrent, papillose on the back above, in cross section with a row of guides just below the ventral row of cells of nearly equal size and a dorsal stereid band with an outer dorsal layer of larger cells; upper leaf cells obscure with small papillae (some C-shaped) irregularly quadrate-hexagonal, 8–12 μ in longest dimension; lower cells smooth, pale, rectangular to elongate-hexagonal, reaching 120 x 20 μ near the base; perichaetial leaves little different. Dioicous; male plants smaller, intermingled with female; antheridial buds terminal or lateral by innovations; seta erect, 7–10 mm. long, rarely more, orange-yellow when young, darker with age; capsule erect, symmetric or nearly so, cylindric; urn about 2 mm. long; operculum conic-rostrate, 0.5–0.75 mm. long, with its upper cells somewhat oblique; annulus large and conspicuous, persistent; peristome papillose, from a basal membrane projecting above the annulus, irregularly divided into two, or rarely three, forks, these sometimes irregularly united, often oblique, reaching 0.75 mm.; spores smooth, about 8 μ in diameter, mature in early spring. Type locality, Easton, Pennsylvania (James).

Illustrations:—Sull. Icones Musc. Suppl. *pl. 23;* M. H. M. 164. *f. 79; Pl. 103.*
Exsiccati:—Aust. l. c.; Holz. Musc. Acro. Bor. Am. 457.
On limestone rocks; Quebec, Ontario; south to Pennsylvania, Ohio, Indiana, Illinois and Missouri. Infrequent.

7. Desmatodon obtusifolius (Schwaegr.) Jur. Laubm. Oesterr.-Ung. 135. 1882.

Barbula obtusifolia Schwaegr. Suppl. **1:** 129. 1811.
Desmatodon oblongifolius Hook. in Drumm. Musc. Am. 114. 1828 (nomen nudum).
Desmatodon arenaceus Sull. in Gray's Manual (Ed. 2) 628. 1856.
Desmatodon ohioense Schimp. Syn. (Ed. 1) 159. 1860.
Desmatodon subtorquescens C. Muell. & Kindb. in Macoun, Cat. Can. Pl. **6:** 48. 1892.
Didymodon arenaceus Kindb. Eur. & N. Am. Bryin. 277. 1897.

Plants closely cespitose, 3–10 mm. high; stems more or less branching and radiculose at base; lower leaves small, the upper larger, 1–2 mm. long, erect-spreading, more or less crispate when dry, oblong-lingu-

late, broadly acute to rounded-obtuse, often apiculate; margin revolute, often nearly to apex, entire; *costa stout, 60 μ or more wide* in the upper middle, vanishing a little below the apex to percurrent and extending into the apiculus, smooth on the back or papillose above, in cross section as shown in *pl. 103. f. 5;* upper leaf cells, obscure, densely papillose with many C-shaped papillae, mostly subquadrate, 8–12 μ in longest dimension, gradually growing larger and smoother from a little above the middle to the base; median basal cells rectangular to elongate-hexagonal, up to 20 μ wide and 90 μ long, narrower toward the margin; perichaetial leaves little different, the inner sometimes smaller. Apparently dioicous; seta erect, up to 1 cm. in length, chestnut colored as is the mature capsule; capsule *oblong to cylindric*, nearly or quite erect and symmetric, urn *2–4 mm. long;* operculum long-conic to obtusely short-rostrate, the upper cells somewhat oblique; *annulus of large cells, rather persistent;* peristome teeth pale, papillose, *variable*, from a basal membrane often slightly higher than the annulus, *usually divided into slender unequal prongs nearly to their base*, sometimes much reduced to rather short irregular lobes; spores smooth, 10–15 μ, apparently mature late summer to autumn. Type locality, Ohio.

Illustrations:—Sull. Icones Musc. *pl. 29;* Jennings, Mosses W. Pennsylvania, *pl. 13;* M. H. M. *pl. 34; Pl. 103.*

Exsiccati:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 93, (Ed. 2) 120; Holz. Musc. Acro. Bor. Am. 17.

On sandy soil and rocks; New Brunswick and Gaspé coast across the continent to Vancouver Island; south to Pennsylvania, Missouri, Arizona and California. Probably most frequent in the valleys of the Ohio and upper Mississippi rivers.

A careful examination of a relatively large number of specimens shows great variations in the size of plants and outline of leaf apices but there seems to be no constant array of characters to separate the European *D. obtusifolius* from the American plants which have been called *D. arenaceus*. Loeske (Annales Bryol. **7**: 197. 1934) considers them to be distinct because *D. obtusifolius* is a lime lover and *D. arenaceus* is found on sandstone. Bearing in mind that sandstone is often cemented by lime compounds, this seems hardly sufficient to separate species. This species is sometimes confused with *Barbula unguiculata*, but the distinctly excurrent costa of the latter will serve to distinguish even sterile plants.

8. Desmatodon Hendersoni (R. & C.) **n. comb.**

Didymodon Hendersoni R. & C. Bot. Gaz. **15**: 40. 1890.

Closely cespitose; stems erect, branching chiefly by innovations, 1–2 cm. long; leaves crowded, spreading when moist, erect-imbricate and subincurved when dry, ovate- to oblong-lanceolate, entire, 0.75–1.75 mm. long, rounded-obtuse to apiculate at apex, sometimes subacute; margins entire, revolute except at base and apex; costa stout, almost percurrent, often somewhat rough on the back above; in cross section with median guides and dorsal stereid band only; upper leaf cells distinct, small, 7–10 μ in longest diameter, irregular in shape and size, thick-walled, minutely papillose, the lower rectangular, longer near the costa, quadrate at the margins, smooth; perichaetial leaves oblong-lingulate, broadly obtuse, with costa ending farther below the apex in the inner. Seta reddish, 10–12 mm. long; capsule erect and symmetric or nearly so, subcylindric; urn up to 2 mm. or more long; operculum long-rostrate, about 1 mm. long; annulus distinct; exothecial cells elongate hexagono-rectangular; peristome teeth about 1 mm. long, very irregularly divided and joined (specimen scarcely mature) very finely papillose. Type locality, crevices of rock, Milwaukee, Oregon (L. F. Henderson). Also found at Arroyo Grande, California and near Seattle, Washington (*Piper*).

The costa structure definitely distinguishes this species from *Didymodon* and indicates *Desmatodon.*

Illustrations:—Bot. Gaz. l. c. *pl. 5C; Pl. 105C.*

9. Desmatodon convolutus (Brid.) **n. comb.**

Trichostomum convolutum Brid. Sp. Musc. **1**: 232. 1806.
Grimmia atrovirens Smith, Eng. Bot. *pl. 2015.* 1809.
Didymodon nervosus Hook. & Tayl. Musc. Brit. 66. *pl. 20.* 1818.
Desmatodon nervosus Bry. Eur. fasc. 18–20. *pl. 132.* 1843.
Tortula atrovirens Lindb. De Tort. 236. 1864.

Plants short, 2–5 mm. high, densely tufted, dark green; leaves close, spreading, imbricate and more or less spirally contorted when dry, oblong-ovate to subspatulate, concave, broadly and shortly acute, up to 2 mm. long; margins entire, strongly revolute; costa stout, percurrent to very shortly excurrent into a stout mucro, usually much thickened in the upper part, sometimes granulose on the upper surface, in cross section as illustrated, papillose on the dorsal side; upper leaf cells rounded-quadrate to irregular, varying consider-

ably in size, 10–18 μ, obscure, minutely papillose on both sides; lower and basal cells smooth, hyaline, rectangular, the marginal shorter. Autoicous; seta erect, reddish; seta 4–12 mm. long; capsule short-oblong to ovoid, erect and symmetric, 1.25–2 mm. long; operculum obliquely conic-rostrate, up to ½ the length of the urn; annulus lacking; peristome teeth from a basal membrane about 60 μ wide, somewhat irregularly divided into two filiform prongs, strongly papillose, little or not at all twisted; spores 18–21 μ, smooth or finely punctate, mature in spring. Type locality, Switzerland.

Illustrations:—Bry. Eur. l. c.; Braithw. Brit. Moss Fl. **1:** *pl. 31;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 24H;* Limpr. Laubm. **1:** 662. *f. 183; Pl. 105B.*

Exsiccati:—Bartram, Mosses S. Arizona 68; Baker, Pacific Coast Bryophytes 366. Holzinger's Musc. Acro. Bor. Am. 233 as *D. plinthobius* from Washington may be a form of this species, it certainly is not *D. plinthobius.*

On earth or stones; apparently frequent in Southern California and Arizona; also found in Lower California and elsewhere in Mexico; Europe, Australia, Asia, Africa.

If *Desmatodon* is to be treated as a genus separate from *Tortula* the only excuse for putting this species in *Tortula* would seem to be the distinct basal membrane. The no. 121, Sull. & Lesq. Musc. Bor. Am. (Ed. 2), referred to the var. *edentulus* Bry. Eur., seems to me to have a peristome broken rather than rudimentary

10. Desmatodon coloradensis n. sp.

Plantae humiles, glauco-virides, gregariae; caulis plerumque simplex, ± 1 mm. altus; folia superiora multo majora, 1 mm. longa, oblonga vel lingulato-oblonga, obtusa vel apiculata, concava, marginata; margine superiore integerrima vel papilloso-crenulata, aliquantum reflexa; costa sub apice desiniente vel in apiculum ingrediente; cellulis superioribus hexagono-quadratis, ± 12 μ latis, utraque pagina valde papillosis. Setae 3–8 mm. longae; capsula oblonga vel cylindraceo-oblonga, erecta, ± 1.3 mm. longa, late annulata; operculo e basi conica breviter rostrato; peristomio e membrana 120–150 μ lata, haud torto; sporis laevibus, ± 9 μ.

Plants gregarious, light green, small; stems not over 1 mm. long, mostly simple, with central strand present; leaves oblong to lingulate, concave, the upper larger, reaching 1 mm. in length, obtuse and often apiculate; margins entire, somewhat reflexed, *unistratose, bordered above by 2–3 rows of yellowish translucent* and less papillose cells; costa strong, ending just below the apex or entering the apiculus, in cross section with a single dorsal stereid band, large ventral cells and inconspicuous guides; upper leaf cells obscure, strongly papillose with mostly C-shaped papillae, hexagono-quadrate, about 12 μ, reaching 15 μ in the longest dimension; *upper marginal cells rectangular, about 12 μ wide, reaching 22 μ in length but usually shorter, 1.5–2 : 1;* basal cells elongate-rectangular, smooth, clear, 30–70 x 12 μ, shorter at the margin; perichaetial leaves larger, subsheathing. Probably dioicous; sporophyte light brown, darker with age; seta erect, 3–8 mm. long; capsule oblong to oblong-cylindric, urn up to 1.3 mm. long; operculum conic-rostrate, about ½ the length of the urn, with cells of the beak subrectangular and oblique; annulus of large cells in about 2 rows, somewhat persistent and falling in pieces; *basal membrane of peristome 120–150 μ wide,* the teeth divided into filiform, irregularly divided and anastomosing, papillose filaments, very fragile and usually much broken on dehiscence, scarcely twisted, reaching 180 μ in length; spores smooth, about 9 μ in diameter, mature in summer. Type from Chucora Camps, Colorado, on rocks by brooks, Aug. 13, 1926 (*Mrs. F. A. MacFadden* no. 107). Type in herb. A. J. G. *Pl. 108.*

Easily distinguished from *Tortula marginata* by the unistratose margin, non-excurrent costa and shorter peristome. Aside from the border the leaves are much like those of some forms of *D. obtusifolius.*

11. Desmatodon Sprengelii (Schwaegr.) Williams, Bull. Torr. Club. **46:** 217. 1919.

Barbula Sprengelii Schwaegr. Suppl. **2**[1]**:** 64. *pl. 119.* 1824.
Plaubelia tortuosa Brid. Bryol. Univ. **1:** 522. 1826.
Weisia Berteroana Sprengel, Syst. Veg. **4:** 156. 1827.
Tortula Donnellii Aust. Bot. Gaz. **3:** 31. 1878.
Barbula Donnellii Lesq. & James, Man. 128. 1884.
Desmatodon Garberi Lesq. & James, Man. 112. 1884.
Hyophila fragilis Card. Rev. Bryol. **36:** 75. 1909.

Plants cespitose; stems simple, slender, 4–5 mm. long; leaves small and distant below, gradually somewhat larger and more crowded above, incurved when dry, spreading when moist, 1–1.5 mm. long, narrowly to broadly oblong-lanceolate, broadly acute to subobtuse and apiculate, entire or slightly serrulate near the

apex, *margins incurved for a greater or less part above the base, often very much so, making the leaves subtubulose;* costa stout, nearly or quite percurrent, sometimes slightly rough on the back above, in cross section with two to four guide cells, bordered by smaller cells on the ventral side and a dorsal stereid band; upper leaf cells usually rather obscure (Williams says distinct), irregularly hexagonal to roundish, 5–8 μ in diameter, mamillose on the ventral side, often strongly so, nearly flat dorsally; basal larger, smooth and quadrate to short-rectangular; perichaetial leaves little different. Dioicous, male flower terminal; antheridia about 0.3 mm. long among longer filiform paraphyses; seta erect, reaching 5 mm. long; capsule erect and symmetric, somewhat fusiform, urn 1–1.5 mm. long; operculum conic-rostrate, a little less to a little more than ½ the length of the urn; stomata few, near the base; peristome teeth reddish-brown, papillose, irregular, jointed and varying in length, more or less divided, often nearly to the base, from a basal membrane of varying width, but never very wide; annulus well developed; spores smooth, 6–8 μ; calyptra cucullate extending down the capsule ½ its length or more. Type locality, Santo Domingo.

Illustrations:—Schwaegr. l. c.; Williams, l. c. *pl. 11, figs. 8 & 9; Pl. 103, 108.*

Florida, Mexico and the West Indies.

The leaves vary a great deal in width and the amount of marginal inrolling, the wider leaved forms are those referred to *D. Garberi* and *Hyophila fragilis.* Other than this the characters used to distinguish the two forms by Williams can be found on plants of the same tuft or even on the same plant.

Schwaegrichen describes the apex as entire, and so it is in many leaves. His illustration gives a much higher basal membrane than is credited or present in most specimens. Perhaps his microscope was not equal to ours. The division of the teeth is not constant even on the same plant, according to Williams. No fruiting plants have been seen from the U. S.

The type of *Tortula Donnellii* is mixed with *Tortula agraria* and *Hyophila tortula.*

12. Desmatodon cernuus (Hueben.) Bry. Eur. fasc. 18–20. *pl. 134.* 1843.

Dermatodon cernuus Hueben. Musc. Germ. 117. 1833.

Cynodontium latifolium Schwaegr. Suppl. 1[1]: 110. 1817 (not *Dicranum latifolium* Hedw. Stirp. Crypt. **1**: 89. *pl. 33.* 1787).

Tortula cernua Lindb. Musc. Scand. 20. 1879.

Desmatodon camptothecius Kindb., in Macoun Cat. Can. Pl. **6**: 48. 1892.

Plants in rather compact cushions, from usually a few mm. in height to rarely 2–3 cm.; stems mostly simple, without central strand; stem leaves more or less erect and contorted when dry, oblong to oblong-spatulate, mostly 2–2.5 mm. long (Williams says up to 3.5 x 1 mm.), slenderly acute to almost obtuse and apiculate; upper margins plane and more or less irregular with projecting cells, of a single layer of cells, below more or less revolute on one or both sides, often of a double layer of 2–4 rows of linear somewhat colored cells; costa *mostly* excurrent into a rather short apiculus, in cross section showing 2–3 median guides with one or two rows of somewhat smaller ventral cells and a dorsal stereid band with larger outer cells; upper median cells rhomboidal to hexagonal, up to 18 x 37 μ, *mostly* finely papillose on both sides but occasionally nearly smooth, narrower at the margins; cells of the lower part smooth, lax, mostly rectangular, up to 30 x 100 μ or more; perichaetial leaves little different. Autoicous; antheridial bud just below the perichaetium; antheridia club-shaped, long-stalked; seta 1.5–2 cm. long, yellowish when young, dark red-brown when old; capsule ovoid, cernuus and unsymmetric; urn up to 1.75 mm. long; exothecial cells elongate-rectangular with a few rows of small cells around the mouth, called annulus by some authors; stomata in one row in the neck below the spore sac; peristome rather short, reddish brown, strongly papillose, each of the 16 teeth divided irregularly into two prongs, which are often perforate below, all united at base, 0.3–0.4 mm. long, not twisted; operculum obliquely short-rostrate, about ⅓ the length of the urn, cells not obliquely arranged; calyptra cucullate, reaching the middle of the urn, smooth; spore large, coarsely papillose, 30–50 μ, in midsummer. Type locality, Austrian Tyrol.

Illustrations:—Schwaegr. l. c. *pl. 28;* Bry. Eur. l. c.; Limpr. Laubm. **1**: 653. *fig. 182;* Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 24F; Pl. 107, 116, f. 11.*

Exsiccati:—Macoun, Can. Musc. 71, 604; Holz. Musc. Acro. Bor. Am. 557.

On soil and limestone débris, apparently calcicolous; Quebec to Alaska; south to Nevada, Colorado, N. Dakota, Wisconsin, and Ohio.

* The leaves of American plants tend to be less slenderly acute than the European as figured in the Bry. Eur. or even spatulate, which is probably the basis for Kindberg's *D. camptothecius.*

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* See *Pottia Randii.*

13. Desmatodon Laureri (Schultz) Bry. Eur. fasc. 18–20. *pl. 135.* 1843.

Trichostomum Laureri Schultz, Flora **10:** 163. 1827.
Tortula bryoides Hook., in Drumm. Musc. Am. 135. 1828.
Tortula Laureri Lindb. De Tort. 243. 1864.

An alpine or subarctic moss very closely allied to *D. cernuus,* differing chiefly as follows: plants usually somewhat larger and more branching; leaves 4–5.5 mm. long, more strongly papillose in the upper portion, with multiple papillae often horseshoe shaped; costa papillose on the back to below the middle, in cross section much the same but with the dorsal layer of cells smaller; margin more recurved above; leaf cells somewhat smaller, seta flexuous; capsule strongly inclined to pendulous, oblong, often nearly symmetric, up to 2.5 mm. or more in length; operculum longer, the cells obliquely arranged in the upper part; peristome longer, 0.5–0.6 mm. long, twisted about once around, less strongly papillose; spores 30–48 μ in diameter, in midsummer. Type locality, Austrian Tyrol.

Illustrations:—Bry. Eur. l. c.; *Pl. 107; 116, f. 12.*
Exsiccati:—Drumm. l. c.
"On humus in rock crevices; Rocky Mts. from British Columbia to Colorado; Vancouver Island; Greenland; also in Europe and Asia."

9. TRICHOSTOMOPSIS Card. Rev. Bryol. **36:** 73. 1909.

Plants small, cespitose; stems erect; leaves crowded, crisped when dry, erect-spreading when moist, larger near the top of the stem, narrowly lanceolate from a broader base, acuminate, obtusely acute, channelled; margins plane or slightly reflexed, entire *more or less bistratose* above; costa percurrent, *with only a dorsal stereid band;* upper cells smooth or papillose, rounded quadrate to hexagonal, lower larger, rectangular and hyaline, smooth; peristome of 16 teeth, divided nearly to the base into two filiform papillose divisions, as in *Barbula* but slightly or not at all twisted. Type species *T. crispifolia* Card. l. c.

This genus differs from *Barbula, Trichostomum* and *Didymodon* in the bistratose margins and single stereid band in the costa.

1. Upper leaf cells 10–12 μ, papillose ..... 2.
   Upper leaf cells 12–15 μ, merely mamillose ..... 3. *Fayae.*
2. Leaves narrowly acuminate; margins mostly plane ..... 1. *brevifolia.*
   Leaves broadly acuminate; margins narrowly recurved in the median region ..... 2. *diaphanobasis.*

1. Trichostomopsis brevifolia Bartram, Bryol. **34:** 61. *pl. 4.* 1931.

Didymodon craspedophyllus of Bartram from the U. S., not of Cardot, Rev. Bryol. **36:** 81. 1909.
Didymodon diaphanobasis var. *angustifolia* Thér. Bryol. **32:** 8. 1929.

Plants short, dark green above; stems 1–2 mm. long, simple or branched; leaves crowded, the lower smaller, oblong-lanceolate, the upper linear-lanceolate, reaching 2 mm. in length, all rather blunt at the narrow apex; costa strong, percurrent; upper cells rounded quadrate-hexagonal, obscure, 10–12 μ in diameter, bistratose in patches above and on the upper margin, papillose with low blunt papillae; perichaetial leaves slightly shorter than those next below and more loosely areolate. Probably dioicous; seta red, erect, 7–9 mm. long; capsule erect and symmetric, cylindric to ovoid-cylindric; urn up to 1.5 mm. long; operculum conic-rostrate, blunt, up to 1 mm. long, with cells in oblique rows; annulus indistinct; peristome teeth divided to the base into two filiform papillose forks, up to 0.6 mm. long, these forks often grouped in fours, slightly twisted spirally; spores smooth, about 10–12 μ in diameter, mature in spring. Type from under shrubs on hill top, Tuna Canyon, Los Angeles Co., California, March 1931. (Mrs. Fay A. MacFadden, no. 8107.) Type in Herb. E. B. Bartram, A. J. Grout and the N. Y. Botanical Garden.

Illustrations:—Bryol. l. c.; *Pl. 109.*
Exsiccati:—Holz. Musc. Acro. Bor. Am. 636 (as *Didymodon craspedophyllus*).
I can find no valid differences between Mrs. MacFadden's plants and those identified by Bartram (doubtfully) as *Didymodon craspedophyllus* Card. from Arizona. (See Bryol. **30:** 47. 1927.) The leaves of the Mexican *D. craspedophyllus* are flatter, wider above and more bluntly acuminate, with the thickened margin more distinct and upper cells about 6–8 μ. The peristome is rudimentary much as in *Weisia Andrewsii.*

2. Trichostomopsis diaphanobasis (Card.) **n. comb.**

Didymodon diaphanobasis Card. Rev. Bryol. **37**: 125. 1910.

Differs from *T. brevifolia* in the taller plants, reaching 2–4 cm. in the sterile plants of the type, shorter in fertile plants, less than 1 cm.; leaves a little longer and much wider at the obtuse apex, with a larger area of hyaline and more elongate basal cells; margins more narrowly revolute in the median region, more narrowly bistratose. Urn of capsule up to 2.5 mm. long; peristome similar but reaching nearly 1 mm. in length; annulus persistent but clearly apparent; operculum long conic-rostrate, reaching 1 mm. Type locality Istaccihuatl, Mexico. (Purpus no. 3721, in part, 1909; type seen) *Pl. 110.*

On soil or rocks; Alpine, Brewster Co., Texas (*Orcutt*, 7162a & 7163, 5,000 ft., May 31, 1926). The plants are dioicous, male mixed with the female; perigonial leaves short, ovate-acuminate, the inner ecostate, all strongly papillose above; paraphyses filiform.

Thériot considered *T. brevifolia* (*Didymodon diaphanobasis* var. *angustifolia*) as a var. of this species and he is probably right in considering them as one specific type. The excellent specimens from Mexico (Fr. Amable 1704 x in the New York Botanical Garden, com. Thériot) are in perfect fruit and abundant antheridia seem to make it certain that the two are at least congeneric.

3. Trichostomopsis Fayae **n. sp.**

Plantae humiles, 3–5 mm. altae; folia superiora majora, ovato-lanceolata, ± 1.5 mm. longa, acuto-obtusa, sursum carinata, margine superiore recurvata, integra, bilamellata; cellulis superioribus ± 15 μ, regulae non consentaneis, orbicularis, utaque pagina ± mamillosis, opacis; costa percurrente. Seta erecta, 1 cm. longa vel minore; capsula erecta, oblongo-cylindracea, ± 1.7 mm. longa, non annulata; operculo rostrato, ± 1 mm. longo; peristomio e membrana angusta, dentibus sedecim, fragilibus, fere ad membranum in crura duo capillaria papillosa tortaque fissis.

Plants small, the fertile stems up to 5 mm. long, usually shorter; leaves subimbricate and incurved when dry, erect-open when moist from a more or less erect base, the upper larger, crowded, ovate-lanceolate, obtusely acute, about 1.5 mm. long, keeled in the upper part, with bistratose margins more or less recurved, very entire; costa 120μ wide near the base, percurrent, in cross section with large median guides, with slightly smaller cells above and below and a few dorsal stereids; upper leaf cells *averaging about 15 μ*, smaller near the margin, irregular and rounded, thick-walled, obscure, *more or less rounded-mamillose on both surfaces*, papillose on the ventral surface of the upper costa; basal cells near the insertion rectangular, smooth, hyaline, reaching 60 x 22 μ, smaller at the margins, gradually becoming shorter and smaller and merging into the upper; perichaetial leaves oblong-lanceolate, the inner with larger cells and often without chlorophyll. Probably dioicous; seta straight and erect, up to 1 cm. long, usually less; capsule usually erect and symmetric, oblong-cylindric, urn up to 1.7 mm. long; operculum long-rostrate, about 1 mm. long, with cells subspirally arranged; annulus not apparent; peristome teeth divided into two filiform prongs to a more or less perforate narrow basal membrane, papillose, segmented, a little shorter than the operculum, *twisted ½ turn or more;* spores smooth, about 10 μ, mature in May. Type from under shrubs, Syringia, Wash. near Sherman Way, Los Angeles Co., California, May 9, 1932 (Mrs. Fay A. MacFadden no. 8172). Type in herbarium of A. J. Grout. *Pl. 110B.*

10. TORTULA Hedw. Fund. Hist. Nat. Musc. **2**: 92. 1782; Sp. Musc. 122. 1801 (in part).

William Campbell Steere[1]

Plants from very small to very large, in dense tufts or loose mats, rarely singly, growing usually on calcareous rocks or soils, more rarely on the trunks of living trees, bright, glaucous, or brownish-green, often

[1] Papers from the Department of Botany and the Herbarium of the University of Michigan, No. 687. Grateful acknowledgment is hereby made to the following individuals and institutions for their generosity in lending specimens for study, as well as in other ways: Dr. A. J. Grout, Mr. E. B. Bartram, Dr. A. J. Sharp, Dr. L. E. Anderson, Mr. R. S. Williams and the New York Botanical Garden, Dr. D. H. Linder and the Farlow Herbarium of Harvard University, Dr. W. R. Maxon and the U. S. National Herbarium, Dr. A. E. Porsild and the Canadian National Museum, Ottawa; and Dr. R. Florin, Director, Riksmuseets, Stockholm, Sweden. I am particularly grateful to Dr. Linder for his permission to use W. S. Sullivant's pencil studies of *Tortula amplexa*, *T. Bolanderi*, and *T. brevipes* as a basis for the illustrations published here.

with a tinge of red; stems erect, usually densely radiculose below, simple or branching either dichotomously or by means of innovations, a central strand of differentiated cells present or absent, often constant and of diagnostic importance, especially in the larger species; leaves commonly widest above the middle, usually oblanceolate, obovate, lingulate or spatulate, rarely oblong, elliptical, or ovate-lanceolate, usually larger and crowded in a rosette at the apex of the stem, little crisped or distorted but often regularly twisted about the apex of the stem and nearly always appressed when dry, erect to widely spreading when moist, more rarely recurved to squarrose-recurved; margin entire or nearly so, revolute throughout or in part, plane or somewhat incurved, usually not differentiated, in a few species bordered by a one- or several-layered band of thickened, colored, elongated, or otherwise modified cells; costa very well developed, from short, ending just above the middle of the leaf, to long-excurrent into an awn as long or longer than the lamina, rather variable in cross section, but almost always consisting of 2–6 large, median guide cells, a ventral row (or rows) of large cells, and a dorsal stereid band whose outermost row may or may not be differentiated; cells of upper leaf blade small, usually strongly papillose and obscure with several high, crescent-shaped or circular papillae, thick-walled, rarely unipapillate, or smooth and clear, or thin-walled; basal cells usually much larger, smooth, hyaline, yellow, or reddish, often in a clearly and suddenly differentiated group on each side of the costa.

Inflorescence monoicous, polygamous, or dioicous; perichaetial leaves (except in *T. amplexa*) very slightly or not at all differentiated; seta short to much elongated, straight, red, twisted when dry; capsule always exserted, erect, ovate to long-cylindric; urn straight to conspicuously curved, dark red or brown, becoming nearly black with age, rarely pale, smooth or striate when dry; calyptra long-beaked, the beak smooth or papillose, cucullate, variable in length and color; operculum usually long-rostrate, blunt or acute, sometimes somewhat oblique, rarely equalling the urn in length; annulus variable, revoluble and deciduous or persistent; peristome inserted below the mouth on a basal tube varying in length from a few microns to a long, pale, tessellated tube more than half the length of the whole peristome, peristome teeth 32, threadlike, papillose, red, pink, or yellow, wound spirally to the left in from less than one to more than two complete turns; spores very small, smooth to somewhat granulose.

Multicellular propagula of various sorts are not uncommon, occurring on the surface of the leaf lamina or costa, or in the leaf axils, and are occasionally of considerable diagnostic importance. Type species, *Tortula subulata* Hedw.

This genus has been defined very narrowly by some recent authors and very broadly by others. Dixon and Jameson (Student's Handbook of British Mosses, Ed. III, 1924) subordinated to *Tortula* such groups as *Pterygoneurum*, *Aloina* and *Desmatodon*. Amann (Flore des Mousses de la Suisse, 1912) not only accorded generic rank to *Pterygoneurum*, *Aloina* and *Desmatodon*, but also gave recognition to *Crossidium* and *Syntrichia* as genera and, still further, split off *Pachyneurum* from *Tortula* as a new genus, a treatment followed in large part by Mönkemeyer (Die Laubmoose Europas, 1927). Although the ancient genus *Syntrichia* is revived from time to time for many members of *Tortula* with a well-developed basal peristome tube, the presence of the same feature in species excluded from *Syntrichia*, even by those who use the name, breaks down the primary generic distinction.

According to the last list compiled (Brotherus in Engler & Prantl, Ed. II, 1924) there have been recognized throughout the world about 200 species of *Tortula*, of which a large proportion will eventually prove to be synonymous with species which are better known.

Key.

1. Plants bearing abundant propagula; most commonly growing on the trunks of living trees ..... 2.
   Plants usually without propagula; growing on soil or rock ..... 6.
2. Propagula borne in the axils of the leaves, at the apex of the stem ..... *14. pagorum.*
   Propagula borne on the surface of the leaf itself ..... 3.
3. Propagula borne only on the upper surface of the costa ..... *13. papillosa.*
   Propagula borne only on the lamina ..... 4.
4. Propagula elongated ..... 5.
   Propagula spherical ..... *16. latifolia.*
5. Propagula borne on upper surface of leaf in the upper half only; costa percurrent ... *11. caroliniana.*
   Propagula borne on upper surface of leaf in the lower half only; costa ending not far above the middle of the leaf ..... *12. propagulosa.*

6. Leaf margin bordered more or less conspicuously with 1–6 rows of thicker-walled, colored, elongated, or otherwise differentiated cells ..... 7.*
Leaf margin not bordered with differentiated cells ..... 10.
7. Differentiated cells of the border much elongated and often bistratose ..... 8. *subulata.*
Differentiated cells of the border not conspicuously or at all elongated, always unistratose ..... 8.
8. Upper leaf cells smooth or nearly so, inner perichaetial leaves long and conspicuously sheathing ..... 5. *amplexa.*
Upper leaf cells densely papillose, obscure ..... 9.
9. Costa long excurrent into a smooth awn ..... 1. *muralis.*
Costa percurrent or ending below the apex ..... 4. *Bolanderi.*
10. Upper leaf cells not at all or only very slightly papillose ..... 11.
Upper leaf cells conspicuously and densely papillose, often obscure or nearly opaque 12.
11. Costa not reaching leaf apex; upper leaf cells about 8 μ in diameter ..... 6. *Williamsii.*
Costa always excurrent as a short mucro or spine; upper leaf cells 18–28 μ in diameter 9. *mucronifolia.*
12. Costa abruptly excurrent as a long awn sometimes equal in length to the rest of the leaf ..... 15.
Costa percurrent, or excurrent as a very short mucro or apiculus, never an awn .... 13.
13. Leaf apex very obtuse, broadly rounded or truncate; costa ending in or below the apex ..... 16. *latifolia.*
Leaf tapering to an acute or obtuse apex, neither broadly rounded nor truncate; costa excurrent as a very short mucro ..... 14.
14. Leaves, especially the older ones, very fragile and brittle; margin revolute only in lower half; dioicous ..... 7. *fragilis.*
Leaves not fragile; margin narrowly revolute nearly throughout; monoicous ..... 10. *inermis.*
15. Excurrent costa completely smooth ..... 16.†
Excurrent costa slightly to very strongly serrate ..... 19.
16. Leaf margin somewhat revolute at the middle, otherwise plane ..... 15. *laevipila.*
Leaf margin strongly revolute from base to apex ..... 17.
17. Basal leaf cells yellow; margin spirally revolute in one or more turns; leaf apex acute or subacute ..... 3. *aurea.*
Basal leaf cells hyaline; margin revolute but not spirally so; leaf apex obtuse, truncate, or even emarginate ..... 18.
18. Capsule long-cylindric; peristome with a well-developed basal tube; dioicous; leaves not bordered ..... 2. *brevipes.*
Capsule elliptical to short-cylindric; peristome with no basal tube; monoicous; leaves faintly to conspicuously bordered with larger, smoother cells ..... 1. *muralis.*
19. Leaves strongly squarrose-recurved when moist ..... 23.
Leaves erect- to wide-spreading, but not squarrose-recurved when moist ..... 20.
20. Margins revolute from base to apex; plants conspicuously glaucous; excurrent costa often as long as the rest of the leaf ..... 22. *obtusissima.*
Margins not revolute to apex, usually only in the lower half or two-thirds, or not at all ..... 21.
21. Leaf margins plane throughout ..... 17. *Bartramii.*
Leaf margins revolute at least in part ..... 22.
22. Plants in loose tufts; monoicous; upper leaf cells 12–16 μ in diameter ..... 23. *princeps.*
Plants in dense tufts or cushions; dioicous; upper leaf cells 8–10 μ in diameter ..... 18. *intermedia.*
23. Leaf margin revolute from base to apex; excurrent costa hyaline, at least in the upper half ..... 24.
Margin plane in upper half or one third; excurrent costa red or reddish-brown throughout, often nearly smooth ..... 21. *norvegica.*

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* *Desmatodon Porteri* may be sought here.
† *Desmatodon plinthobius* may be sought here.

24. Leaf apex obtuse to emarginate, the costa suddenly excurrent ..... *19. ruralis.*
Leaf apex gradually narrowed to an acute, dentate, hyaline point which runs into and joins the excurrent costa ..... *20. ruraliformis.*

1. TORTULA MURALIS Hedw. Sp. Musc. 123. 1801.

Barbula muralis Web. & Mohr, Bot. Tasch. 206. 1807.

Plants densely caespitose, bluish- or glaucous green, often appearing hoary from the excurrent, hyaline costae; stems branching dichotomously, 5–15 mm. high, central strand present, well-developed; leaves infolded, incurved, and slightly to conspicuously twisted at the apex of the stem, but not much crisped, when dry, erect-spreading when moist, 2–3 mm. long, the upper elongate-ligulate to spatulate, obtuse, often emarginate, rarely shortly acute at the apex; margin broadly and tightly revolute completely to the apex, usually bordered with a row or two of more strongly thickened cells which are less papillose; costa very rough-papillose at the back, abruptly excurrent as a very long, smooth, hyaline, rarely yellowish hair, consisting in cross section of 2 median guide cells, about 4 ventral cells and several dorsal layers of stereids, whose outer row is differentiated toward the base; basal leaf cells hyaline, smooth, rectangular and linear, becoming much smaller above, roundish-quadrate, green, very densely and irregularly papillose on both sides. Monoicous. Seta straight, 1–2 cm. long, yellow at first, but becoming dark red with age; capsule erect, cylindric, usually somewhat curved, reddish-brown, becoming very dark; calyptra reaching the middle of the urn; operculum usually ⅓ the length of the urn, narrowly conical, crenate at the margin, its cell rows spirally wound in several complete turns; annulus of 2–3 rows of cells, revoluble; cells of the exothecium elongate-rectangular, shorter toward the mouth; tube of the peristome low, teeth 2–3 times spirally wound; spores usually 7–9 μ, yellow, smooth, ripening in spring. Type locality, Europe.

ILLUSTRATIONS:—Braithw. Brit. Moss-Fl. **1**: *pl. 31G, figs. 1–8;* Dixon, Handb. Brit. Mosses (Ed. III) *pl. 25B;* Bry. Eur. *pl. 159;* Grout, Mosses with Hand-lens (Ed. III) *pl. 34* and *fig. 41;* Hook. and Tayl. Musc. Brit. *pl. 12;* Husnot, Musc. Gall. *pl. 28, figs. 1–8, pl. 29, figs. 9–13;* Mönkemeyer, Laubm. Eur. *fig. 64a;* DeNot. Musci Ital. *pl. 12, figs. 1–17;* Roth, Eur. Laubm. *pl. 2, figs. 1, 4–6, pl. 22, fig. 4a–e;* Sim, Bryoph. of So. Africa, p. 230; Smith, English Bot. *pl. 2033;* Wilson, Bryol. Brit. *pl. 12;* M. H. M. *fig. 76.*

EXSICCATI:—Drumm. Musci Am. S. States, 63; Austin, Musci Appal. 130; Ren. & Card. Musci Am. Sept. 164 (as *Barbula*); Holz. Musci Acro. Bor. Am. 16; Grout, Musci Perf. 14; Bartram, Mosses of So. Ariz. 137.

Growing on calcareous rocks, rarely on soil; widespread from New England south to the Gulf States, westward through the southern and central United States to California, where it is rare and replaced in large part by *T. brevipes* (Lesq.) Broth.

This common and variable species is most apt to be confused, when sterile, with *Desmatodon plinthobius* Sulliv., but that species has smaller leaf cells, no differentiated cells at the leaf border, and crescent-shaped or circular papillae, which are not irregularly verruculose as in *T. muralis.* There is a great deal of variation in the size of specimens, in the degree to which the leaf margin is revolute, in the length of the excurrent costa and even in the shape of the leaves, yet none of the variations seem to be stable enough to justify nomenclatorial recognition, even as varieties.

2. TORTULA BREVIPES (Lesq.) Broth. in Engler & Prantl, Nat. Pflanzenfam. **1** (3): 431. 1902.

Barbula brevipes Lesq. Mem. Calif. Acad. Sci. **1**: 12. 1868.
Barbula macrotricha Card. & Thér. Bot. Gaz. **37**: 367. 1904.
Tortula macrotricha Broth. in Engler & Prantl, Nat. Pflanzenfam. **1** (3): 1195. 1909.

Plants loosely to densely caespitose, bluish- to grayish-green, stems extremely short, to 3 mm., usually about 1 mm., unbranched; leaves densely crowded, infolded lengthwise, twisted spirally at the apex of the stem and somewhat crisped when dry, erect-spreading to widely spreading when moist, 2–3 mm. long, spatulate, lingulate or oblong-cuneiform, concave above, the apex obtuse to truncate; margins widely and tightly revolute in the upper two-thirds, with no perceptible border of thicker-walled or discolored cells; costa reddish-brown, finely papillose to nearly smooth on the back, abruptly excurrent into a long, hyaline, smooth awn to 1 mm. in length, in section consisting of 2 median guide cells, about 4 large ventral cells, and a dorsal band of stereids in several rows, the outer layer scarcely differentiated; basal leaf cells large, rectangular, hyaline, smooth, becoming smaller, roundish-quadrate to hexagonal, densely and irregularly verrucose-papillose on both sides, isodiametric above, about 15 μ in diameter. Dioicous (or very rarely monoicous ?); male inflorescence terminal on much smaller plants; female inflorescence with paraphyses.

Seta erect, 15–18 mm. long, red below, yellow above; capsule erect, narrow, long-cylindric, the urn 3.5 mm. long, straight to somewhat curved, reddish-brown, becoming black with age; operculum about 1.5 mm. long, narrowly conic, obtuse, the cell-rows strongly twisted; annulus of 2–3 rows of cells; tube of the peristome conspicuous, ⅓ to ½ the length of the teeth, obliquely quadrate-tessellate, the teeth a dusty, glaucous red, twisted more than one full turn; spores yellow, smooth, 10–12 μ in diameter. Type locality, California.

Illustrations:—*Pl. 112.*

Exsiccati:—Sull. & Lesq., Musci Bor. Am. (Ed. II) 143 (as *Barbula laevipila*); Baker, Pacific Slope Bryophytes 360 (as *Barbula muralis* forma *stenocarpa*); Holz. Musci Acro. Bor. Am. 233b (as *T. plinthobia*), 281; Grout, Musci Perf. 200.

Growing on calcareous soil, California to Washington, east to Utah (*Garrett*), Colorado, and Idaho, apparently taking the place, in large part, of *T. muralis* Hedw.

This species is closely related to *T. muralis*, but may be easily distinguished when in fruit by the very long capsule, which with the operculum may reach more than 5 mm., and by the well-developed basal tube of the peristome. The leaves are also somewhat wider, and the marginal row of cells is not noticeably differentiated, as in *T. muralis*. *T. brevipes* is apparently also closely related to the European *T. canescens* (Bruch) Mont., especially in the basal tube of the peristome, but differs in the more strongly revolute leaf margins and the longer capsules.

3. Tortula aurea Bartram, Bull. Torrey Bot. Club **51**: 339. 1924.

Plants robust, in deep, rather loose cushions, yellowish-green above, light brown beneath; stems branched above or simple, sparingly radiculose below; leaves spirally twisted when dry, erect-spreading when moist, about 2 mm. long, ovate-lanceolate, tapering above to a sub-acute apex, cuspidate by the stout, excurrent costa which is occasionally prolonged into a smooth yellow hair-point half as long as the leaf; margins spirally once or more revolute from base to apex; costa light brown, strong, about 90 μ wide from base to apex, smooth, short- or long-excurrent, in cross-section showing 2 large median guide cells with one layer of about 3 somewhat smaller cells on the ventral side and a thick stereid band of 3 or more layers on the dorsal side with the outer row of cells somewhat larger; basal cells yellow, linear in the median part, 1 : 8 or 1 : 10, broader and shorter at the extreme base and short-rectangular to quadrate toward the margins with yellowish pellucid walls, gradually shorter above, in upper half quadrate-hexagonal, 10–12 μ in diameter, densely chlorophyllose and obscure with numerous papillae on both sides. Probably dioicous, male flowers not found, female flowers terminal or lateral by innovations; archegonia numerous, usually shrunken and unfertilized, with slender paraphyses. Sporophyte unknown. Type locality, Arizona.

Illustrations:—Bartram, Bull. Torrey Bot. Club **51**: *pl. 6, figs. 1–11; Pl. 111.*

Exsiccati:—Bartram, Mosses of So. Ariz. 98, 138; Holz. Musci Acro. Bor.-Am. et Eur. 649.

Mr. Bartram supplements the original description of this moss with the following notes: "Frequent and abundant on dry shaded ledges in the foothills of the Santa Catalina Mts. and the Tucson Mts. The absence of sporophytes leaves the relative position of this species rather uncertain but the characters in the aggregate seem to indicate a relationship to *Tortula muralis*, from any form of which it is abundantly distinct in leaf outline, spirally revolute margins and in the pellucid basal areolation without any suggestion of hyaline cells." Since the original description of *T. aurea* from Arizona specimens, the range of the species has been extended to western Texas, New Mexico and Mexico, through collections made by C. R. Orcutt.

4. Tortula Bolanderi (Lesq.) Broth. in Engler & Prantl, Nat. Pflanzenfam. **1** (3): 430. 1902.

Barbula Bolanderi Lesq. Trans. Amer. Phil. Soc. **13**: 5. 1865.

Plants gregarious, not tufted, dirty green to dark reddish-brown; stems short, 5–10 mm. high, simple or sparingly branched, central strand scarcely differentiated; leaves crowded toward the apex of the stem, rarely in interrupted rosulate or verticillate tufts along the stem as in *T. princeps*, imbricated and very slightly twisted about the apex of the stem, but little contorted when dry, stiffly erect-spreading when moist, oblong or lingulate, rarely spatulate or obovate, 1.5 to 2.5 mm. long, the apex blunt and concave; margins reflexed or narrowly revolute in the basal half, usually plane in the upper half, but occasionally revolute, conspicuously bordered from base to apex with 4–6 rows of thicker-walled, yellowish or reddish-brown cells in one layer; costa thick, yellowish or reddish-brown, smooth on the back, ending just below the blunt leaf apex, rarely very shortly mucronate, in cross section showing two very large median guide cells, 2 ventral cells and a dorsal band of 2–3 layers of stereids, whose outermost layer is not differentiated; basal leaf cells large, rectangular, lax, hyaline, except the marginal 4–6 rows which are narrower, thicker-walled and dis-

colored, upwards gradually becoming smaller, isodiametric, quadrate to hexagonal, the upper cells 8–15 μ in diameter, densely papillose and obscure, becoming smaller, thicker-walled, somewhat clearer and yellow or brownish toward the margin, which is crenulate-papillose. Dioicous, the inner perichaetial leaves not differentiated. Seta straight, dark red, 8–12 mm. long; capsule erect, cylindric, urn straight or slightly curved, about 2 mm. long, red, becoming very dark with age, irregularly striate when dry but not contracted below the mouth; operculum long-conic, somewhat obtuse, about half the length of the urn; annulus narrow, persistent; cells of exothecium rectangular; peristome teeth twisted in several complete turns, yellowish-red, papillose, from a very short, striate, papillose basal membrane; spores small, smooth or slightly granulose, 8–10 μ in diameter. Type locality, "near the Bay of San Francisco," California.

Illustrations:—*Pl. 112.*
Exsiccati:—Sull. & Lesq., Musci Bor. Am. 139; Holz. Musci Acro. Bor. Am. 180 (as *Barbula amplexa*), 280, 499.
On rocks and soil, California to Washington.
This species seems distinct from all other North American species of *Tortula*, except the following, through the blunt leaves bordered with several rows of smaller, thicker-walled, yellower cells. It is apparently allied to *T. marginata* (Bry. Eur.) Spruce, but in that species the marginal cells are much elongated and bistratose.

5. Tortula amplexa (Lesq.) **n. comb.**

Barbula amplexa Lesq., Trans. Amer. Phil. Soc. **13:** 5. 1865.

Plants densely gregarious, with a strong brownish or reddish tinge; stems short, 1–5 mm. long, central strand indefinite, branches few; leaves laxly appressed or irregularly spreading and somewhat crisped when dry, erect-spreading when moist, 1.5–2.5 mm. long, long-lingulate, apex obtuse or rarely sub-acute; margin entire, closely revolute nearly throughout or plane throughout, variable on the same plant, inconspicuously or conspicuously bordered by several rows of thicker-walled yellow cells which are isodiametric above and elongated below; costa yellow to reddish-brown, well-developed, ending in or just below the apex of the leaf, rarely slightly excurrent as a very short mucro, smooth on the back except very near the apex, where it may be sharply papillose, in cross section showing 2–4 rather thick-walled median guide cells, 2 ventral cells and about 2 rows of dorsal stereids, whose outer layer is differentiated only toward the base of the leaf, all cells of the costa showing collenchymatous thickenings in the cross section; leaf cells in the basal half of the leaf extremely lax, hyaline, rectangular, marginal cells longer, narrower, thicker-walled, sometimes with collenchymatous thickenings, yellow; upper leaf cells thin-walled, smaller, isodiametric, quadrate to hexagonal, 15–20 μ in diameter, becoming gradually smaller, thicker-walled, and discolored toward the margins, swollen or somewhat mamillose and inconspicuously papillose to nearly smooth, very transparent. Dioicous; the inner perichaetial leaves long-linear-lanceolate, obtuse, erect, clasping at the base, deeply concave above. Seta straight, red, to 2 cm. long; capsule erect, short- to long-cylindric, the urn 1.5–2 mm. long, straight or slightly curved, pale yellowish- or reddish-brown, becoming darker with age, somewhat contracted below the mouth when dry; operculum long-conic, its rows of cells twisted in several turns, nearly equalling the length of the urn; annulus persistent; cells of exothecium rectangular, often much elongated; peristome teeth papillose, yellowish-red, becoming pale with age, closely twisted in several complete turns, from a very low, papillose, somewhat fenestrate basal membrane; spores small, smooth, yellowish-green, 8–10 μ in diameter, apparently ripening in late summer. Type locality, near San Francisco, California.

Illustrations:—*Pl. 112.*
Exsiccati:—Sull. & Lesq. Musci Bor. Am. (Ed. II) 140; Lesq. Calif. Mosses 140.
The type material was collected "on stones, in springs near San Francisco," according to the Lesquereux and James Manual, and is still known from California only, although it has been reported from farther north.
T. amplexa is most closely related to *T. Bolanderi* (Lesq.) Broth., and field studies may eventually prove it to be only an ecological variation of that species. For the present, however, *T. amplexa* may be held separate on the basis of its much more lax areolation, sheathing inner perichaetial leaves, and poorer development of papillae on the leaf cells. The border of thicker-walled, yellow cells is even more marked than in *T. Bolanderi*, and often persists in old leaves after the tender tissue closer to the costa has disintegrated and completely disappeared. The capsule of *T. amplexa* is lighter in color and thinner-walled than in *T. Bolanderi*, and the seta is much longer. The species seems to prefer springs and dry washes where for part of the year it must receive considerable water.

6. Tortula Williamsii Bartram, Bryol. **27**: 70. 1924.

Plants in loose mats, yellowish to bright green above, light brown beneath, stems to about 1.5 cm. high, branched, upper part and innovations sparingly radiculose, without central strand; leaves 2–3 mm. long, loosely twisted and contorted when dry, erect-spreading when moist, ovate-spatulate from a narrow base, obtuse to suddenly bluntly acute; margins entire and plane above, narrowly recurved on one or both sides near the base; costa light brown, about 75 μ wide at base, tapering upward and vanishing below the apex of the leaf, in cross section near the middle of the leaf consisting of two median guide cells, with one layer of smaller cells on the ventral side and a thick stereid band of three or more layers on the dorsal side with the outer row of cells somewhat larger; upper leaf cells densely chlorophyllose and nearly opaque, smooth, more or less oval-hexagonal, about 8 μ in diameter, with very slightly and irregularly thickened walls, nearly uniform except at the extreme base where four or five rows near the costa are rectangular, 1 : 2 to 1 : 4, gradually becoming smaller and shorter towards the margins. Evidently dioicous; male flowers unknown; female flowers terminal, or lateral by slender innovations from just below the perichaetium; archegonia few, shrunken and unfertilized, with numerous slender, 4- to 6-celled paraphyses. Sporophyte unknown. Type locality, Santa Rita Mountains, Arizona.

Illustrations:—Bartram, Bryol. **27**: *pl. 11, figs. 1–10; Pl. 113.*

Exsiccati:—Bartram, Mosses of So. Ariz. 125; Bauer, Musci Eur. et Amer. Exsicc. 1833; Holz. Musci Acro. Bor. Am. et Eur. 548.

Mr. Bartram amplifies his original description of *T. Williamsii* with the following remarks: "Rather widely and abundantly distributed over the Santa Rita Mts., and the Patagonia Mts., on ledges in narrow shaded ravines above 5,000 ft. The plants are unusually distinct from any *Tortula* previously described from the United States and may represent the northern outpost of some subtropical species of Mexican distribution." This species is still known only from southern Arizona, where, however, Mr. Bartram has made numerous collections of it. It is one of the very few species whose leaf cells lack papillae. Although *T. mucronifolia* Schwaegr. also exists in Arizona, it may be distinguished by its larger size, excurrent costa and larger leaf cells.

7. Tortula fragilis Tayl. Lond. Journ. Bot. **6**: 333. 1847
(not *T. fragilis* C. Hartm. Skand. Fl. (ed. 7) 377. 1858).

Barbula fragilis C. Müll. Syn. Musc. **1**: 634. 1849 (not *B. fragilis* Wils. Bry. eur. Mon. Suppl. IV. p. 1. 1855).
Barbula Trianae Hampe, Ann. Sci. Nat. Ser. V. **3**: 350. 1865.
Tortula confusa Card. Rev. Bryol. **36**: 87. 1909.
T. Pringlei Card. Rev. Bryol. **36**: 87. 1909.
T. fragilifolia Bartram, Bull. Torrey Bot. Club **51**: 358. 1924.

Plants robust, in dense cushions, dark green above, reddish-brown below, lustrous throughout; stems 1–4 cm. high, branched above, closely matted together with reddish radicles; leaves infolded lengthwise and closely spirally incurved when dry, erect-spreading when moist, up to 3 mm. long, slightly concave, oblong-spatulate to ovate-oblong in outline, apex obtuse, shortly mucronate or apiculate by the somewhat excurrent reddish-brown costa; margins plane or narrowly revolute in the middle, distinctly crenately lobed in the upper half, often torn and broken in various ways; leaf cells large, rectangular and hyaline at the base, a well-defined area of larger cells with reddish-brown or orange walls in the median part, on either side of the costa, bordered by a marginal band of about six rows of much smaller, short-rectangular cells, quickly becoming shorter and hexagonal-quadrate above, the upper cells 10–12 μ in diameter, clearly arranged in rows and often in well-defined blocs, densely papillose on both sides with several crescent-shaped, round or forked papillae; costa reddish-brown, minutely but sharply papillose on the back, slightly mucronate-excurrent, in cross section consisting of two large median guide cells, about three smaller ventral cells in one or two layers and a thick dorsal stereid band of three or more layers with the outer cells little or not differentiated. Dioicous. Seta 8–14 mm. long, red; capsule erect, long-cylindric, about 4 mm. long, usually curved, with a conspicuous neck; calyptra hardly longer than the operculum; operculum about 1 mm. long, narrowly conical, blunt to acutish at the apex, its cell rows twisted in about one full turn; annulus of 2 rows; cells of the exothecium thin-walled, rectangular, becoming shorter toward the mouth; tube of the peristome about $\frac{1}{6}$ the length of the teeth, which are twisted about one full turn; spores about 10 μ in diameter, yellow, smooth or inconspicuously punctulate, apparently ripening in late summer. Vegetative propagation

through ecostate, ovate-acuminate, verrucose propagula in the form of imbricated brood-leaves which are borne on reduced branches found sparingly in the axils of the upper stem leaves. Type locality, Ecuador.

ILLUSTRATIONS:—Bartram, Bull. Torrey Bot. Club **51:** *pl. 7, figs. 1–11; Pl. 111.*

EXSICCATI:—Bartram, Mosses So. Ariz. 87 (as *T. fragilifolia*), 71, 91 (as *T. alpina* var. *inermis*); Holz. Musci Acro. Bor. Am. et Eur. 574 (as *T. fragilifolia*); Bauer, Musci Eur. et Amer. Esxic. 2113.

Growing on rocks and trees, apparently most common in Mexico and the American Southwest, but extending to Virginia (*Leonard*) and West Virginia (*Gray*).

Bartram (Bull. Torrey Bot. Club **51:** 338) says of Arizona specimens of this species: "The dense cushions closely bound together by radicles, the very fragile structure of the lamina and the strongly crenately lobed margins would seem sufficient in the aggregate to give the plant a specific identity. It seems to be well distributed over the Santa Rita Mts. on bark near the base of oak trees above 6000 ft. but is more robust and characteristically developed at altitudes of 7500 ft. and over." Later, in speaking of a number of American specimens, Bartram (Bryologist **29:** 53–54. 1926) says: "There seems to be a progressive tendency toward broader and shorter leaves as the northern limit of the range is approached, but a considerable variation in leaf-outline may be observed, even in the same collection, and it seems impossible to draw any satisfactory line of demarcation. The lamina may be so exceedingly fragile that only fragments remain attached to the persistent nerve or it may continue almost intact at the other extreme, but it invariably shows a brittle quality that is characteristic of the species. The detached fragments probably serve the same purpose as the propagula in so many other species of this genus. I have no direct evidence of the fact, but in several instances pieces under microscopical observation have shown a decided elongation of the marginal cells strongly suggestive of vegetative reproduction. Plants growing on a rock substratum seem to have a less fragile lamina than those found on the bark of trees."

A polymorphic and variable species, as the synonymy shows. The Arizona material matches fairly well the Argentina specimens collected by Hosseus and distributed by Bauer as No. 2113, cited above, but differs in shorter stems, more fragile leaves and shorter mucro. It is apparently most closely related to *Tortula alpina* var. *inermis*, which is not now recognized in North America. European bryologists do not seem to have recognized the brittle, fragile nature of the older leaves, which shows a closer relationship to *T. fragilis* than they have suspected.

8. TORTULA SUBULATA Hedw. Sp. Musc. 122. 1801.

Barbula subulata P. Beauv. Prodr. 43. 1805.

Plants densely caespitose in often extensive tufts, bright to glaucous green, discolored below; stems usually about 1 cm. high, rarely reaching more than 2 cm., branches few, densely radiculose below; leaves incurved, variously crisped and contorted when dry, erect-spreading when moist, crowded at the apex of the stem, oblanceolate to long-spatulate, acute, concave, 3.5–7.0 mm. long; margins plane, often reflexed at the base, bordered by 1–4 rows of longer, narrower, thicker-walled, papillose, yellow to reddish-brown cells in one or two layers, disappearing toward the leaf apex which may be slightly to conspicuously dentate; costa strong, yellowish-green to brown, inconspicuously papillose on the back, excurrent as a discolored spine, consisting in section of 2–4 large median guide cells, several large ventral cells and a several-layered dorsal band of stereids whose outer layer is not differentiated; basal leaf cells smooth, rectangular and hyaline, except for the yellow margin, upper cells quadrate to hexagonal, isodiametric, 13–18 μ in diameter, each cell strongly papillose on both sides with several high, curved papillae often grouped in circles. Monoicous. Seta 1–3.5 mm. long, red; capsule erect, very long-cylindric, urn to 7 mm. long, arcuate, reddish-brown; calyptra very large; operculum acutely conical, obtuse, $\frac{1}{3}$–$\frac{1}{5}$ the length of the urn, about 2 mm. long, dentate at the margin; annulus of 2–3 rows of cells, persistent or deciduous in fragments; cells of exothecium rectangular; basal tube of peristome pale red, obliquely tessellate, always longer and sometimes twice as long as the teeth, which are red, papillose and twisted at least one full turn; spores about 12 μ in diameter, yellowish-green, smooth, ripening in spring. Type locality, Europe.

ILLUSTRATIONS:—Braithw. Brit. Moss-Fl. **1:** *pl. 32B, figs. 1–8;* Bry. Eur. *pl. 160;* Dixon, Handb. Brit. Mosses (Ed. III) *pl. 25D;* Hedw. Sp. Musc. *pl. 27, figs. 1–13;* Schwaegr. Suppl. **1**[1]**:** *pl. 34, figs. 1–7;* Hook. & Tayl. Musc. Brit. *pl. 12;* Husnot, Musc. Gall. *pl. 32, figs. 1–13;* Limpr. Laubm. *fig. 184;* Mönkemeyer, Laubm. Eur. *fig. 64c;* DeNot. Musci Ital. *pl. 21, figs. 1–16;* Roth, Eur. Laubm. *pl. 17, fig. 9, pl. 24, fig. 5a–d;* Smith, English Bot. *pl. 1101;* Warnstorf, Kryptogamenfl. Mark Brandenb. **2:** 45, *fig. 16,* 279, *fig. 9a–b;* Wilson, Bryol. Brit. *pl. 12; Pl. 116.*

EXSICCATI:—Macoun, Canad. Musci 217, 610 (as *Barbula*), 217a (as *Barbula subulata* var. *longifolia*); Canad. Crypt. 22, 217a (as *Barbula subulata* var. *longifolia*); Flora Canad. 2103 (as *Barbula*); Holz. Musci Acro. Bor. Am. 338.

On soil, California to British Columbia.

In its characteristic form, this species is completely unmistakeable. The densely papillose, opaque leaves, bordered with longer, yellow or reddish-brown cells, and the very well developed basal tube of the

peristome present a combination of features found in no other species of *Tortula*, yet most of the specimens labelled "*T. subulata*" in American herbaria are actually *T. mucronifolia*, *T. inermis* or some other species.

8a. Var. ANGUSTATA (Wils.) Limpr. Laubm. **1**: 671. 1888.

Tortula angustifolia Wils. in Lindb. de Tort. 243. 1864.

Closely resembling the American form of *T. subulata*, from which it differs in the taller and more slender habit, the longer, narrower leaves narrowed to a more acute apex, the border distinct completely to the leaf apex, which is more conspicuously toothed. In the sporophyte, the seta and capsule tend to be more slender.

ILLUSTRATIONS:—Braithw. Brit. Moss-Fl. **1**: *pl. 32C, figs. 1–8;* Dixon, Handb. Brit. Mosses (Ed. III) *pl. 25E; Pl. 116.*

I have seen several specimens from California which matched European specimens very closely. Material identified as *T. angustata* from other places has all turned out to be something else. So many intermediate forms exist between this plant and *T. subulata* that the former cannot safely be given specific rank, nor even recognized as a subspecies, especially since it is not separated geographically from the species.

9. TORTULA MUCRONIFOLIA Schwaegr. Suppl. **1**[1]: 136. 1811.

Barbula mucronifolia Bryol. Eur. Mon. p. 38. 1842.
B. subcuneifolia Kindb. Rev. Bryol. **23**: 22. 1896.
Tortula subcuneifolia Broth. in Engler & Prantl, Nat. Pflanzenfam. **1** (3): 430. 1902.
Barbula brachypoda Card. & Thér. Wash. Acad. Sci. **4**: 303. 1902.
Tortula brachypoda Broth. in Engler & Prantl, Nat. Pflanzenfam. **1** (3): 1195. 1909.
T. gelida Mitt. in herb.

Plants densely caespitose, a clear bluish-green to dark green; stems branching through innovations, to 10 mm. long; leaves incurved at the apex, crisped and twisted when dry, erect-spreading when moist, crowded, long-spatulate, acute to acuminate, about 3 mm. long; margin usually closely revolute toward the base, often inconspicuously bordered in the lower part with several rows of longer, yellow cells; marginal cells in the upper part rarely thicker-walled or slightly papillose, almost never elongated; costa conspicuous in dry plants, excurrent as a yellow mucro or longer excurrent as a yellow spine, occasionally somewhat dentate at the base, smooth on both sides, consisting in section of 2 median guide cells, 2–4 ventral cells in 2 layers, and a dorsal band of stereids; basal leaf cells elongated, hyaline, becoming shorter above, quadrate to hexagonal, 18–28 μ in diameter, slightly smaller toward the margins, rarely thicker-walled and somewhat discolored; trigones well developed and often conspicuous, smooth or rarely with a few low papillae, often very convex-bulging, always clear and transparent. Monoicous. Seta 1–2 cm. high, red; capsule erect, dark brown, the urn long-cylindric, straight or slightly curved, 3.5–6 mm. long; operculum long-conic, $\frac{1}{3}$–$\frac{1}{2}$ the length of the urn, to 2 mm. long; annulus of 2–3 rows of cells, persistent; basal tube of the peristome white or pink, nearly equalling the red, closely-twisted teeth in length; spores 14–18 μ in diameter, yellow-green, finely punctate, ripening in late summer. Type locality, Switzerland.

ILLUSTRATIONS:—Broth. Laub. Fennosk. *fig. 29M;* Bry. Eur. *pl. 162;* Husnot, Musc. Gall. *pl. 32, figs. 1–6;* DeNot. Musci Ital. *pl. 22, figs. 1–14;* Roth, Eur. Laubm. *pl. 24, fig. 1a–c;* Schwaegr. Suppl. l. c. *pl. 35, figs. 1–6;* M. H. M. *pl. 36.*

EXSICCATI:—Sull. Musci Allegh. 147 (as *Barbula*); Sull. & Lesq. Musci Bor. Am. (Ed. I) 99, (Ed. II) 141 (as *Barbula*); Drumm. Musci Am. 144 (as *T. subulata*); Austin, Musci Appal. Suppl. 497 (as *T. subulata*); Macoun, Canad. Musci 80 (as *Barbula*); Flora Canad. 2097 (as *Barbula*); Canad. Mosses 70a (as *T. subulata angustata*), 80 (as *T. subulata*); Clements, Crypt. Format. Colo. 195 (as *Barbula subulata*); Bartram, Mosses of N. Mex. 34 (as *T. subulata*); Holz. Minnesota Mosses 62 (as *Barbula*), Mosses of Colorado 12, Musci Acro. Bor. Am. 88; 648 (as *T. alpina*); Grout, Musci Perf. 163.

A common and widespread species growing on soil and rocks; Greenland across the Arctic Archipelago to Alaska, southward to New York, Iowa, New Mexico, Arizona and California; very rare on the Pacific Coast, where its place seems to be taken by *T. subulata*. According to Limpricht and other European bryologists this is an alpine and boreal moss of rather restricted distribution in Europe, whereas in North America it is not at all limited to high altitudes and latitudes, but is abundant almost throughout the northern and western United States, with the exception of the Pacific Coast. The natural suspicion that the North American moss might be a species different from the European one is not substantiated by a comparison of specimens, as they agree in nearly all respects. American specimens vary much more greatly in size, often reaching in every part more than twice the size of European specimens. Toward the north the plants become reduced in size and approach European specimens more closely. There has been a very general confusion of *T. mucronifolia* with *T. subulata*, in this country. To be sure, the upper leaf cells of

T. mucronifolia are obscurely to rather conspicuously papillose in many specimens, as pointed out to me many years ago by Mr. H. R. Becker, but the cells never lose their transparency. The geographic ranges of the two species are very distinct, overlapping to some extent only in the Pacific Northwest, where somewhat intermediate forms naturally occur. In general, however, the two species are abundantly distinct, as a comparison of authentic specimens will show.

10. TORTULA INERMIS (Brid.) Mont. Arch. Bot. **1**: 136. 1832.

Barbula inermis C. Müll. Syn. Musc. **1**: 624. 1849.
Tortula subulata var. *inermis* Spruce, Ann. Mag. Nat. Hist. **2**: 376. 1849.

Plants densely caespitose, bright bluish-green to very dark green, becoming darker below; stems to 2 cm. high, little branched; leaves folded lengthwise, incurved, appressed, contorted and characteristically spirally coiled or twisted when dry, erect to erect-spreading when moist, crowded at the apex of the stem, long-lingulate, shortly acute, usually obtuse, concave, 2.5–5 mm. long, rarely reaching 1 mm. in width; margin entire, not bordered, narrowly but conspicuously revolute throughout, strongly papillose-crenulate; costa red-brown, very thick, densely papillose on both sides, ending in the leaf apex or excurrent as a very short apiculus, consisting in cross section of 2–4 median guide cells, 2 layers of large ventral cells, and a many-layered dorsal stereid band, of which the outer layer is not or only slightly differentiated; basal leaf cells rectangular and hyaline, a few at the extreme margin shorter and yellow, upper leaf cells roundish-quadrate to hexagonal, isodiametric, 12–16 μ in diameter, thickened at the angles, very densely multi-papillose on both sides with high, curved or crescent-shaped papillae. Monoicous. Seta 15–25 mm. long, reddish-brown; capsule erect, narrowly cylindric, the urn averaging about 4 mm. long, curved, dark reddish-brown, becoming purplish-black with age; operculum one-third the length of the urn, about 1.5 mm. long, long-conic, acute, margin dentate, red; annulus of 2–3 rows of cells; cells of exothecium long-rectangular, the long walls more strongly thickened; basal tube white, densely papillose, one-third to one-half the length of the peristome, which reaches nearly 2 mm., the teeth pale, papillose, twisted more than one full turn; spores 10–12 μ, yellowish-green, minutely granulose, maturing in spring. Type locality, France.

ILLUSTRATIONS:—Bry. Eur. *pl. 167;* Husnot, Musc. Gall. *pl. 32, figs. 1–5;* Mönkemeyer, Laubm. Eur. *fig. 63g;* DeNot. Musci Ital. *pl. 20, figs. 1–12;* Roth, Eur. Laubm. *pl. 24, fig. 3a–c; Pl. 103.*

EXSICCATI:—Sull. & Lesq. Musci Bor. Am. (Ed. I) 99b, (Ed. II) 142; Holz. Musci Acro. Bor. Am. 521; Bartram, Mosses of So. Ariz. 10, 93.

On rocks and soil throughout the southwest; California, Nevada, Utah, Wyoming, Colorado, Arizona, and New Mexico.

This species is close to *T. subulata*, but easily distinguished by the short costa and leaf margins narrowly revolute from base to apex. The leaves of dry plants have a very curious and characteristic coiled appearance. The monoicous inflorescence and high, white basal tube of the peristome will serve to distinguish this from other species with sub-acute leaves and a percurrent or mucronate costa.

11. TORTULA CAROLINIANA Andrews, Bryol. **23**: 72. 1920.

Plants densely caespitose, bright green above, brown below; stems strong, sparingly branched, up to 10 mm. long, but rarely more than 5 mm., radiculose below, round in section, the outer 2–3 rows of cells gradually smaller and thicker-walled than those within, central strand present; leaves incurved and somewhat crisped when dry, erect-spreading when moist, obovate, averaging about 2.5 mm. long, reaching 1 mm. wide in widest part, margins strongly reflexed in the basal half, apex abruptly apiculate, but the costa only percurrent; costa brown to red, very conspicuous in dry plants, slender, averaging about 50 μ in width in lower part of leaf, smooth on the back, consisting in section of two guide cells with two ventral cells of nearly equal size adjoining them, and a dorsal area of uniform stereid cells; basal leaf cells smooth, rectangular, the outer ones narrow and somewhat chlorophyllose, up to 50 x 10 μ, in region of costa larger, hyaline with brown walls, up to 70 x 25 μ, upper leaf cells irregularly roundish-quadrate to polygonal, isodiametric, averaging about 15 μ in diameter, with fairly thick walls and distinct trigones, near the margin slightly smaller and with thicker walls, but never giving the impression of a distinct border, papillose on both surfaces with regularly crescent-shaped or rarely circular papillae, normally 4 per cell on each side, rarely more than 6, in smaller cells of border region often 2 or 3, rather low in profile and entirely independent of each other, the wall to which they are attached not at all thickened. Sex organs and sporophyte completely unknown. Vegetative propagation by means of very numerous propagula, more or less cylindrical in shape, with rounded ends, produced from and perpendicular to the ventral surface of upper half of leaf blade, the

cells from which they originate generally slightly smaller than those surrounding them, often lacking chlorophyll and with papillae less distinct or lacking; propagula densely chlorophyllose, somewhat roughened on outer surface, multicellular, divided by parallel planes at right angles to the long axis at intervals of 20–25 μ, up to 8 divisions, these divisions often further subdivided into 2–4 parts by planes at right angles, the end segments usually smaller and undivided, the whole propagulum varying in width up to 45 μ and the length up to 200 μ or more. Type locality, Swannanoa, Buncombe County, North Carolina.

ILLUSTRATIONS:—Andrews, Bryol. **23:** *plate 5, figs. 1–10; Pl. 113.*
EXSICCATI:—Holz. Musci Acro. Bor. Am. & Eur. 625; Pringle, Plantae Mex. 10449 (in part), 10618 (in part), 15308 (in part).
Plants growing on bark of deciduous trees (beech, oak, chestnut); North Carolina, Tennessee, Mexico, Costa Rica.
This species differs most strikingly from *T. papillosa* Wils. in the recurved basal margins, the percurrent (not excurrent) costa, the very different papillae, and the much larger propagula arising from the ventral leaf surface rather than entirely from the ventral surface of the costa. According to Sharp (Bryologist **36:** 20. 1933) some of the Mexican specimens of *T. caroliniana* (Pringle 10618, for example) have propagula on both surfaces. *T. pagorum*, of course, produces its propagula in the leaf axils and in the terminal bud. For the differences from *T. propagulosa* see the description of that species.

12. TORTULA PROPAGULOSA Sharp, Bryol. **36:** 20. 1933.

Plants gregarious to densely caespitose, dark green above, blackish below; stems slender, very short, rarely over 5 mm. in height, rather freely branching, round in cross section, central strand rudimentary or lacking; leaves 1.0–1.5 mm. long, to 0.3 mm. wide, incurved at the apex when dry, but scarcely crisped; spatulate, the apex obtusely acute to acute; margins plane throughout, not bordered; costa conspicuously white in dry specimens, very short and delicate for the genus, from one-half to two-thirds the length of the leaf, never percurrent, 55 μ in width in the lower part, smooth, in cross section with 2 ventral guide cells and 9–13 dorsal stereids; basal leaf cells rectangular, up to 50 x 25 μ, smooth except for the pedicels upon which the propagula are borne, median and upper leaf cells more densely chlorophyllose, smooth, often bulging, roundish-quadrate to hexagonal, isodiametric, averaging about 25 μ in diameter, cell walls slightly thickened, with indistinct trigones. Sex organs and sporophyte completely unknown. Vegetative reproduction by means of basal innovations and numerous, generally cylindrical, smooth, densely chlorophyllose, multicellular propagula, divided at right angles to their long axis, about 40 μ wide, up to 200 μ long; the propagula-producing cells differentiated only by the papilla-like spurs which bear the propagula. Type locality, Knoxville, Tennessee.

ILLUSTRATIONS:—Sharp, Bryol. **36:** *pl. 1, figs. 1–5; Pl. 116.*
EXSICCATI: Grout, Musci Perf. 255; Verdoorn, Musci Sel. et Crit. 99.
Growing in soot-filled crevices of bark of elm; still known only from several parts of Knoxville, Tennessee, the type locality.
The short costa and complete lack of papillae separate this species from all other similar ones. *T. caroliniana* Andrews approaches *T. propagulosa* more closely in macroscopic character than any other species, but may be distinguished at once by the percurrent costa in the leaves and by the papillose propagula and leaf cells.

13. TORTULA PAPILLOSA Wils. Spruce, in Lond. Journ. Bot. **4:** 192. 1845.

Barbula papillosa C. Müll. Syn. Musc. **1:** 598. 1849.

Plants occurring singly or in very small but dense tufts, dark green, brownish when dry; stems short, reaching 10 mm., but rarely surpassing 5 mm., branching; leaves incurved at the apex and imbricated when dry, hardly crisped, spreading widely when moist, broadly obovate to spatulate, about 2 mm. long, reaching 1 mm. in width at the widest part, rounded, truncate, or retuse at the apex, margins involute when dry, plane or nearly so when moist; costa thick and spongy, pale, very conspicuous in dry plants, strongly spinose- to stellate-papillose on the back, propaguliferous on the ventral side, in the upper part, especially in young leaves, excurrent into a mucro or short, smooth awn, in cross section consisting of 2 median guide cells, about 4 large ventral cells and a dorsal group of stereids; basal leaf cells rectangular, hyaline toward the costa, upper leaf cells rounded quadrate to polygonal, 20–25 μ in diameter, with rather thick and conspicuous trigones, transparent, often nearly smooth on the upper side but short to spinose-papillose on the back. Reproduction through oval or roundish multicellular propagula of a bright yellowish-green, borne on short pedicels, very numerous on the younger leaves but usually lost on the older ones, 50–80 μ in diameter. Sporophyte unknown in the northern hemisphere. Type locality, England.

ILLUSTRATIONS:—Braithw. Brit. Moss-Fl. **1**: *pl. 32E, figs. 1–11;* Broth. Laubm. Fennosk. *fig. 29G–H;* Dixon, Handb. Brit. Mosses (Ed. III) *pl. 26C;* Grout, Bryol. **7**: *pl. 8, figs. 1–2;* Husnot, Musc. Gall. *pl. 33, figs. 1–6;* Limpr. Laubm. **1**: *fig. 185;* Mönkemeyer, Laubm. Eur. *fig. 64e;* Roth, Eur. Laubm. *pl. 1, fig. 10, 13, pl. 25, fig. 2a–c;* Sim, Bryoph. So. Africa p. 226; Warnstorf, Kryptogamenfl. Mark Brandenb. **2**: 279, *fig. 7a–c;* Wilson, Bryol. Brit. *pl. 44;* M. H. M. 167. *f. 79b.*

EXSICCATI:—Sull. & Lesq., Musci Bor. Am. (Ed. I) 95c, (Ed. II) 127; Austin, Musci Appal. 133; Holz. Musci Acro. Bor. Am. 235.

On the bark of living trees (especially elms); apparently most common in the northeastern states, ranging south to Virginia and North Carolina (*Anderson*), west to Michigan (*Schnooberger*) and Illinois. A single collection from California, correctly identified, has been seen, but no collections have apparently been made in the intervening territory.

This species is not apt to be confused with any other corticolous species because of the leaf margins involute when dry and the abundant gemmae borne directly on the upper surface of the rather fleshy costa. The leaf cells are unique in the genus for their single, simple papillae.

14. TORTULA PAGORUM (Milde) DeNot. Epil. Briol. Ital. 542. 1869.

Barbula pagorum Milde, Bot. Zeit. **20**: 469. 1862.
Tortula laevipila (Brid.) DeNot. var. *propagulifera* Lindb. de Tort. 245. 1864.
Tortula alpina (Bry. Eur.) Bruch, var. *propagulifera* Limpr. Laubm. **1**: 683. 1888.
Syntrichia laevipila Brid. var. *pagorum* Mönkem. Laubm. Eur. 309. 1927.

Plants densely caespitose in small to extensive mats or cushions, very fragile, clear green, becoming darker when dry, often with a reddish tinge; stems up to 10 mm. high, but usually less than 5 mm., radiculose at base, central strand present but somewhat indefinite; leaves mostly in a terminal rosette, the lowermost very small, incurved and closely appressed when dry, not crisped, but often slightly twisted, erect-spreading when moist, obovate, lingulate or panduriform, concave above, 2.0–2.5 mm. long (including awn), about 1 mm. wide, at the apex rounded, truncate or rarely retuse; leaf margin plane, not bordered, rarely slightly inflexed, strongly papillose-crenulate; costa pale red, thick, smooth on the back, excurrent as a smooth or rarely somewhat roughened awn, up to 1 mm. long, very conspicuous in dry plants, in cross section showing 2 median guide cells, 2 ventral cells of nearly equal size, and a larger dorsal stereid group; basal leaf cells hyaline, with yellow walls, the cross walls often thickened, rectangular toward the costa, shorter toward the margins, cells of the upper three-quarters of the leaf much more densely chlorophyllose, roundish-quadrate to hexagonal, isodiametric, about 12 μ in diameter, papillose with numerous high, crescent-shaped or circular papillae. Dioicous; archegonial plants not uncommon; antheridial plants unknown in our range. Sporophyte completely unknown. Vegetative reproduction through lanceolate to elliptic and ovate densely papillose or verrucose, ecostate, leaf-like propagula with a smooth or faintly papillose hyaline apical spine, produced at the apex of the stem and in the axils of the comal leaves, 200–250 $\mu \times$ 80–100 μ. Type locality, Switzerland.

ILLUSTRATIONS:—Limpr. Laubm. **1**: *fig. 186;* Jaeggli, Boll. Soc. Ticinese Sci. Nat. **1933**: 11; Bryol. **7**: *pl. 8, figs. 3–5;* **23**: *pl. 1, figs. 1–4;* **23**: 33, *fig. 1;* **33**: 41, *fig. 1,* 42, *fig. 2;* Bartram, Bull. Torrey Bot. Club **51**: *pl. 7, figs. 12–17;* Mönkemeyer, Laubm. Eur. *fig. 63f;* Roth, Eur. Laubm. *pl. 25, fig. 3a; Pl. 114.*

EXSICCATI:—Small, Mosses of Southern States 39 (as *T. papillosa*); Holz. Musci Acro. Bor. Am. 360, 500; Bartram, Mosses So. Ariz. 15; Grout, Musci Perf. 191; Verdoorn, Musci Sel. et Crit. 98.

On the trunks of living trees, very rarely on rocks, Ohio, West Virginia and Maryland, south to Georgia, west to Oklahoma, Texas, Arizona and California.

The taxonomic status of this moss has been much debated, and its identity as a species not always recognized, as the synonymy listed above will show. Most American authors have considered this distinct enough from *T. laevipila,* especially in the propagula and dioicous inflorescence to merit specific rank, and recent European investigations seem to substantiate such a treatment (cf. Jaeggli, Boll. Soc. Ticinese Sci. Nat, **1933**: 1–11).

T. pagorum is distinct from the other corticolous, propaguliferous *Tortulae* in that its propagula are borne at the apex of the stem or in the axils of the upper leaves, but not on the costa or surface of the leaves themselves, as in *T. papillosa, T. caroliniana,* and *T. propagulosa.* The leaf cells of *T. papillosa* bear on their dorsal surface only one large papilla, whereas in *T. pagorum* the cells are multi-papillose on both surfaces with small, crescent-shaped or circular papillae.

15. TORTULA LAEVIPILA (Brid.) Schwaegr. Suppl. **2**[1]: 66. 1823.

Syntrichia laevipila Brid. Musc. Recent Suppl. **4**: 98. 1819.
Barbula laevipila Bry. Eur. Mon. p. 40. 1842.

Plants caespitose, usually densely so, dark green to brownish; stems to 3 cm. high, usually 1–2 cm., radiculose at the base, dichotomously branched or with many innovations, central strand present; leaves

infolded, inflexed and appressed, twisted at the apex of the stem when dry, widely spreading when moist, long-spatulate, acute or obtuse, rarely emarginate; margin rarely somewhat lighter colored through 4–5 rows of thicker-walled cells, usually revolute in the middle; costa smooth or nearly so, brown, suddenly excurrent into a long, slightly toothed or smooth hyaline awn, consisting in cross section of 2 central guide cells, 2 large ventral cells, and a dorsal band of stereids whose outermost layer is undifferentiated; basal leaf cells smooth, rectangular, hyaline, those in the first marginal rows shorter and narrower, the upper cells thick-walled, densely papillose on both sides with several crescent-shaped papillae, quadrate, 10–18 μ in diameter. Monoicous. Seta 8–15 mm. long, reddish-yellow to red; capsule long-cylindric, erect, urn straight or somewhat curved, brown; calyptra reaching below the middle of the urn; operculum about one-third the length of the urn, narrowly conical, usually acute, cell rows spirally wound in several turns; cells of exothecium rectangular and longer, the long walls strongly thickened; annulus of 2 rows of cells, long persistent; tube of the peristome well-developed, pale, tessellate; peristome teeth wound in two or three complete turns; spores variable in size, from 10–18 μ, greenish-brown, papillose, ripening in spring. Type locality, Germany.

Illustrations:—Braithw. Brit. Moss-Fl. **1**: *pl. 32F, figs. 1–10;* Bry. Eur. *pl. 164;* Dixon, Handb. Brit. Mosses (Ed. III) *pl. 25G;* Husnot, Musc. Gall. *pl. 33, figs. 1–10;* Jaeggli, Boll. Soc. Ticinese Sci. Nat. **1933**: 11; Mönkemeyer, Laubm. Eur. *fig. 64f;* Roth, Eur. Laubm. *pl. 25, fig. 10a–d;* Schwaegr. Suppl. **2**[1]: *pl. 120, figs. 1–13;* Warnstorf, Kryptogamenfl. Mark Brandenb. **2**: 279, *fig. 6a–c;* Wilson, Bryol. Brit. *pl. 43; Pl. 117.*

On the trunks of living trees, California and Nevada, north to Oregon and Washington; rare.

Plants of this species resemble to some extent small plants of *T. ruralis*, but are abundantly distinct in the corticolous habitat, the smooth or only faintly serrulate excurrent costa, and the leaf margin plane in the upper part. From *T. pagorum* this differs in the lack of propagula, although Limpricht (Die Laubmoose, **1**: 680. 1888) describes vegetative propagation through brown, multicellular, long-cylindric propagula produced on the upper surface of the leaves.

16. Tortula latifolia Bruch, Recens. Gen. Barbula. 38. 1823.

Syntrichia latifolia Hüben. Deutsch. Laubm. 342. 1833.
Barbula latifolia Bry. Eur. Mon. 41. 1842.
Tortula mutica Lindb. Musc. Scand. 20. 1879.

Plants in loose, fragile tufts, dirty to blackish-green; stems to 2–3 cm. high, usually about 1 cm., radiculose at the base, dichotomously branching; leaves lax, folded lengthwise, twisted and crisped when dry, wide-spreading when moist, the lower leaves distant, obovate, the upper leaves in a rosette-like cluster, 2–3 mm. long, about 1 mm. wide, spatulate, broadly rounded, often somewhat emarginate, rarely very short-apiculate or mucronate, but never with an awn; the margin usually reflexed in the lower half, plane or involute above, no differentiated border present; costa ending in the leaf apex, brownish, spinulose-papillose on the back, very strong, showing in section 2 median guide cells, usually 2 large ventral cells in 2 layers, and 3–5 rows of dorsal stereid cells; basal leaf cells hyaline even at the margins, rectangular to elongated, becoming shorter and very chlorophyllose above, rather conspicuously arranged in parallel rows, roundish-quadrate to hexagonal, isodiametric, about 10 μ in diameter, thin-walled, irregularly verruculose-papillose on both surfaces, the marginal row less strongly papillose. Dioicous. Seta 8–12 mm. long, yellow or pale above, red below; capsule erect, long-cylindric, urn 3 mm. long, straight or only slightly curved; calyptra covering a third of the urn; operculum to 1.5 mm. long, one-half the length of the urn, long-conic, acute, cells spirally twisted in about one complete turn; cells of the exothecium thin-walled, elongate-rectangular; annulus of 2–3 rows of cells, long-persistent; peristome pale, basal tube about 0.5 mm. high, peristome teeth wound in one or more complete turns; spores 10–12 μ, yellowish-brown, smooth, ripening in early spring. Vegetative propagation through small, green to brown, spherical, multicellular propagula produced in abundance over the upper surface of the leaf blade, becoming 25–35 μ in diameter. Type locality, Germany.

Illustrations:—Braithw. Brit. Moss-Fl. *pl. 32D, figs. 1–8;* Broth. Laubm. Fennosk. *fig. 29E–F;* Bry. Eur. *pl. 164;* Dixon, Handb. Brit. Mosses (Ed. III) *pl. 25F;* Husnot, Musc. Gall. *pl. 32, figs. 1–7;* Mönkemeyer, Laubm. Eur. *fig. 64d;* Roth, Eur. Laubm. *pl. 1, fig. 14, pl. 25, fig. 5a–c;* Warnstorf, Kryptogamenfl. Mark Brandenb. **2**: 279, *fig. 8a–c;* Wilson, Bryol. Brit. *pl. 43; Pl. 117.*

Exsiccati:—Sull. & Lesq. Musci Bor. Am. (Ed. II) 144.

On the base of trees, especially in wet places subject to inundation; known from California to British Columbia, but only from a few specimens.

The American specimens, although very similar to European specimens (Husnot's "Musci Galliae" No. 514, for example) differ in their smaller size and greener color, and the costa is only spinulose on the back, instead of being stellate-spinose. Furthermore, the seta is longer than in European material. Since the plants grow in moist places which may at times be flooded, the older parts of the plants, at least, are usually encrusted with mud. However, an inspection of the newest growth will show the characteristic round or truncate leaf apex and the still more characteristic spherical propagula produced directly on the surface of the leaf blade.

17. Tortula Bartramii **n. sp.**

Plantae dense caespitosae, flavivirides vel fuscescentes; caulibus brevibus, 5–15 mm. longis; foliis appressis, superioribus si desiccatis paulum tortis, sed madidis erecto-patentis, lingulatis vel spatulatis 1.5–2.0 mm. longis, apice acutiusculis vel obtusis; costa crassa, vix ad apicem versus angustata, dorso spinulosa, in aristam excurrente crassam conspicue angustatam serratam 0.5–1.0 mm. longam basi solum rubescentem vel omnino hyalinam; cellulis basalibus magnis, rectangulis, hyalinis sursum, et versus margines parvioribus chlorophyllosisque, superioribus isodiametricis, densissime verrucoso-papillosis, obscuris, opacis. Dioicae ut videtur, sed archegoniatae solae visae. Sporogonium ignotum. A *T. pagorum* differt costa spinulosa, arista serrata et propagulis nullis. Specimen typicum ex loco "White House Canyon" dicto, montibus "Santa Rita," Santa Cruz Co., Arizona, in rupibus a E. B. Bartram (n. 794) lectum, 2 Feb., 1924, in herb. Univ. Mich.; dupla in herb. cl. Bartram et N. Y. Bot. Gard.

Plants densely caespitose in thin cushions, yellowish-green, dark green tinged with reddish-brown when dry; stems short, 5–15 mm. long, radiculose only at the base, sparsely dichotomously branched, with few innovations; leaves appressed, infolded lengthwise, and somewhat twisted at the apex of the stem when dry, erect-spreading and completely flat or slightly concave when moist, upper leaves larger and more crowded, lingulate to spatulate, 1.5–2.0 mm. long (not including excurrent costa), 0.6–0.8 mm. wide in the widest part, apex subacute to obtuse, rarely truncate; margin plane throughout or rarely slightly and narrowly revolute about half way up the leaf, the outermost cells not different in size, color, or thickness of wall, densely verrucose-papillose; costa thick, scarcely tapering, 80–100 μ wide from base to apex, reddish-brown, spinulose on the back, excurrent into a stout, conspicuously tapering, serrate awn 0.5–1.0 mm. long, hyaline throughout or red in the lower part, showing in cross section 2–4 very large guide cells, 2 ventral cells as large as the guides or 4 smaller ventral cells in 2 rows, and a thick dorsal band of 4–6 layers of stereids, the outermost layer undifferentiated except for somewhat thicker walls and the presence of spinulose papillae; cells of the basal quarter of the leaf on both sides of the costa large, hyaline, evenly rectangular, becoming smaller, shorter and chlorophyllose toward the margins and toward the apex, upper leaf cells somewhat seriate, 10–12 μ in diameter, roundish-quadrate to irregularly polygonal, isodiametric, very thick-walled, chlorophyllose and extremely densely verrucose-papillose, the leaf very obscure or opaque from a combination of the two factors. Apparently dioicous; archegonial plants common; perichaetial leaves undifferentiated; male plants not known. Sporophyte completely unknown. Type specimen from rock crevices, White House Canyon, at 6000 ft. altitude, Santa Rita Mountains, Santa Cruz County, Arizona, collected by E. B. Bartram, February 2, 1924, No. 794. (Type specimen in the Herbarium of the University of Michigan; cotypes in the Herbaria of the New York Botanical Garden and E. B. Bartram.)

Illustrations:—*Pl. 115.*

Exsiccati:—Bartram, Mosses So. Arizona 794.

Mr. Bartram (*in litt.*) informs me that this species is very common in southern Arizona. I have seen many of his collections from rock faces and rock crevices in the Santa Rita, Patagonia, and Santa Catalina Mountains. The range is extended to New Mexico through several specimens collected by the late Bro. Arsène (distributed as *T. pagorum*), and to California through a single specimen.

It may be unwise to describe a new species from sterile material in as polymorphic and variable a genus as *Tortula*, but neither Mr. Bartram nor I can place this plant in any known North American species, and it seems to present consistently sufficient individuality in its vegetative character to separate it satisfactorily from all other species. The plants suggest *T. pagorum* in the very flat leaves with plane margins throughout, but differ in the costa spinulose-papillose on the back, and strongly toothed in the excurrent part. Furthermore, the upper leaf cells are much more densely papillose and obscure than in *T. pagorum*. *T. laevipila* is out of the question for the same reasons. The shorter awn and larger leaf cells distinguish it from *T. intermedia*. The plants in some ways resemble very poorly developed *T. ruralis* or *T. norvegica*, but the wide distribution of plants showing great constancy and agreement in morphology seems to preclude any possibility of a starved form of a larger species. Also, the completely plane leaf margins differ very strongly from the conspicuously revolute margins of *T. ruralis* and *T. norvegica*. This new species is most appropriately named after the man who not only collected the original material, but is also distinguished for his contributions to our knowledge of the American species of *Tortula*.

18. TORTULA INTERMEDIA Brid. in Berk. Handb. Brit. Mosses 251. 1863.

Syntrichia intermedia Brid. Bryol. Univ. **1**: 586. 1826.
Barbula intermedia Milde, Bryol. Siles. 129. 1869.
Tortula montana Lindb. Musc. Scand. 20. 1879.
Barbula leptotricha C. Müll. & Kindb. in Macoun, Cat. Canad. Pl. **6**: 60. 1892.

Plants in large, dark brownish- or reddish-green tufts; stems without a central strand, covered below with a loose, reddish-brown tomentum, 1–4 cm. high, branched; leaves crowded, erect-spreading with only the apex recurved when moist, appressed and infolded lengthwise but not much twisted when dry, oblong-spatulate, obtuse to emarginate at the apex, concave, 2–4 mm. long; margin widely revolute at the base, plane above; costa reddish-brown, rough on the back, abruptly excurrent into a long, hyaline, serrate awn, in cross section showing 2 median guides, 2 layers of large ventral cells, and a thick dorsal stereid band whose outer cells are not differentiated; upper leaf cells very densely papillose and chlorophyllose, nearly opaque, 9–10 μ in diameter, basal cells longer and hyaline, rectangular in the center and much narrower at the basal margins. Dioicous. Seta 1.0–1.5 cm. long, red; capsule erect, urn straight, short-cylindric, 2.5–3.0 mm. long, brown, operculum long-conic, about one-half the length of the urn, acute, its cell-rows only slightly twisted; annulus of 2–3 rows of cells, long persistent; peristome tube pale, about as long as the papillose teeth, which are usually twisted less than one full turn; spores 10–15 μ, brown, slightly papillose, ripening in spring. Type locality, France.

ILLUSTRATIONS:—Braithw. Brit. Moss-Fl. **1**: *pl. 33A, figs. 1–7;* Dixon, Handb. Brit. Mosses (Ed. III) *pl. 25H;* Husnot, Musc. Gall. *pl. 33, figs. 1–5;* Limpr. Laubm. **1**: *fig. 183;* Mönkemeyer, Laubm. Eur. *fig. 65a;* DeNot. Musci Ital. *pl. 15, figs. 1–12;* Roth, Eur. Laubm. *pl. 17, fig. 18, pl. 25, figs. 8a–c; Pl. 118.*
EXSICCATI:—Austin, Musci Appal. 132 (as *Barbula ruralis* var. *rupestris*); Macoun, Canad. Musci 226 (as *Barbula latoexcisa*); Canad. Crypt. 66a (as *T. pulvinata*); Holz., Musci Acro. Bor. Am. 256 (as *Barbula laevipila*).

On calcareous rocks and soils, across northern North America, south to New Jersey in the east, where it is very rare, reaching California and Arizona in the west.

This species is most apt to be taken for an underdeveloped form of *T. ruralis*, from which it may be distinguished by the darker color, the spreading, but not squarrose leaves, the leaf margins plane above, the smaller leaf cells and the more emarginate leaf apex.

19. TORTULA RURALIS (Hedw.) Smith, Engl. Bot. 2070. 1808.

Barbula ruralis Hedw. Sp. Musc. 121. 1801.
Syntrichia ruralis Brid. in Schrad. Journ. **3**^{2}: 299. 1801.
Barbula laeviuscula Kindb. in Macoun, Cat. Canad. Pl. **6**: 265. 1892.
Tortula laeviuscula Broth. in Engler & Prantl, Nat. Pflanzenfam. **1** (3): 435. 1902.

Plants in loose tufts or mats which are often of wide extent, bright green above when moist, reddish- or golden-brown when dry; stems lacking a central strand, bearing a sparse reddish tomentum, especially at the leaf bases, dichotomously branching; leaves squarrose-recurved from a somewhat sheathing base when moist, loosely appressed, plicate and somewhat twisted when dry, especially at the apex of the stem, long oblong-spatulate, 3–7 mm. long, including the awn, blunt, truncate, or rarely emarginate at the apex; sharply carinate; margin revolute to or nearly to the apex; costa red or brown, sharply and densely spinose-papillose on the back, excurrent into a long, sharply-serrated awn (1–3 mm. long) which may be hyaline throughout or reddish at the base; in cross section showing 2 central guide cells, a double layer of large ventral cells, and a thick dorsal band of stereid cells, of which the outermost row is not differentiated; upper leaf cells green, densely verrucose- or rarely stellate-papillose, often nearly opaque, 12–16 μ, at the base of the leaf becoming much larger, longer and hyaline, except at the margins where the shorter, narrower cells are yellowish or greenish. Dioicous. Seta 1–3 cm. long, red; the capsule erect, long-cylindric, urn straight or very slightly curved, 3–5 mm. long, brown; operculum long and narrowly conic, about half the length of the urn, rarely somewhat oblique; annulus of 1–3 rows of cells, persistent, at least in part; basal tube of the peristome a pale, dusty red, obliquely tessellate, nearly or quite as long as the red, papillose peristome teeth, which are twisted at least two full turns; spores 10–14 μ in diameter, brownish, slightly granulose, ripening in spring. Type locality, Germany.

ILLUSTRATIONS:—Braithw. Brit. Moss-Fl. **1**: *pl. 33B, figs. 1–7;* Bry. Eur. *pl. 166;* Dixon, Handb. Brit. Mosses (Ed. III) *pl. 26A;* Grout, Mosses with Hand-Lens (Ed. III) *pl. 35;* Hedw. Fund. Hist. Nat. Musc.

Frond. **1**: *pl. 6, figs. 29–32;* Hook. & Tayl. Musc. Brit. *pl. 12;* Husnot, Musc. Gall. *pl. 33, figs. 1–8;* Mönkemeyer, Laubm. Eur. *fig. 64g;* DeNot. Musci Ital. *pl. 14, figs. 1–13;* Roth, Eur. Laubm. *pl. 17, fig. 17, pl. 25, fig. 7a–c;* Schwaegr. Suppl. **1**[1]: *pl. 34, figs. 1–4;* Sim, Bryoph. So. Africa, p. 226; Smith, English Bot., *pl. 2070;* Warnstorf, Kryptogamenfl. Mark Brandenb. **2**: 279, *fig. 3a–c;* Wilson, Bryol. Brit. *pl. 12;* M. H. M. *pl. 35.*

Exsiccati:—Drumm. Musci Am. 143; Austin, Musci Appal. 131 (as *Barbula*); Sull. & Lesq. Musci Bor. Am. (Ed. I) 100, (Ed. II) 145, 146 (as *Barbula*); Ren. & Card. Musci Am. Sept. 165; Macoun, Canad. Mosses 63a; 67a (as *T. pseud-aciphylla*); 68a (as *T. laeviuscula*); 82 (as *T. submegalocarpa*); 502 (as *Barbula pseudo-aciphylla*); Canad. Musci 79, 606 (as *Barbula megalocarpa*); 83 (in part, as *Barbula Muelleri*); Canad. Crypt. 23 (as *Barbula alpina*), 24 (as *Barbula papillinervis*), 25 (as *Barbula laeviuscula*), 123 (as *Barbula*); Holz. Mosses of Colo. 13 (as *Barbula Muelleri*), Mosses of Minnesota 13 (as *Barbula*), Musci Acro. Bor. Am. 180, 181, 181b; 234 (as *T. aciphylla*), 425 (as *T. montana*), 575 (as *T. princeps*); Allen, Mosses of Cascade Mts. 20; Univ. of Wyoming, Plants of Ariz. 2129; Bartram, Mosses of N. Mex. 55, Mosses of So. Ariz. 7; Grout, Musci Perf. 104, 306.

Growing on soil and rocks of many types, although usually calcareous. This is our most ubiquitous and variable species, and is widespread through all of Canada, much of the United States, and well into Mexico.

Although extremely variable in size, as a reflection of its tolerance for different environmental conditions, this species may usually be recognized by the obtuse leaves which are deeply carinate, even when moist, and then squarrose-recurved, the leaf margins revolute from base to apex, the extremely hispid excurrent costa, and the unfailingly dioicous inflorescence.

20. Tortula ruraliformis (Besch.) Dixon, Handb. Brit. Mosses. 188. 1896.

Barbula ruraliformis Besch. Bull. Soc. Bot. Fr. **11**: 334. 1864.
Tortula ruralis (Hedw.) Smith var. *arenicola* Braithw. Brit. Moss-Fl. **1**: 226. 1885.

Plants in deep, dense tufts, yellowish- or reddish-brown, more rarely green above, reddish below; stems without central strand, branching rather freely, 2–8 cm. long; leaves very strongly squarrose-recurved when moist, appressed when dry, ovate-lanceolate to oblong, narrowed gradually into an acute, hyaline, dentate point which runs into and joins the awn; margin revolute nearly to the apex; costa reddish, excurrent into a very rough awn confluent with the hyaline, toothed uppermost part of the lamina; green cells of upper lamina as in *T. ruralis* or somewhat smaller, basal areolation as in *T. ruralis*. Dioicous. Sporophyte as in *T. ruralis*. Type locality, France.

Illustrations:—Dixon, Handb. Brit. Mosses (Ed. III) *pl. 26B;* Husnot, Musc. Gall. *pl. 33, figs. 1–2;* Mönkemeyer, Laubm. Eur. *fig. 65d; pl. 116.*

Exsiccati:—Canad. Musci 79 (in part; as *Barbula megalocarpa*).

Although in Europe this species grows characteristically in sand, and is often nearly buried in it, I have seen no American specimens from sand, but only from a soil or rock substratum. Widespread from northern California to British Columbia on the Pacific Slope, east to Colorado, Wyoming and Montana.

This moss, when well developed, is very characteristic, of about the same size and with much the same habit as *T. ruralis*, the leaves of some specimens even more squarrose-recurved. The leaves are different in shape, however, tapering gradually to an acute, hyaline, dentate or serrate point which runs into and joins the excurrent costa. The confluence of the hyaline leaf margin and hyaline costa reminds one strongly of the similar condition characteristic of some species of *Rhacomitrium*, for example *R. lanuginosum*. As intermediate forms linking this with *T. ruralis* commonly occur, *T. ruraliformis* is considered by some bryologists as a variety of it. Dixon considers it to be of only subspecific rank, and I agree that if it is recognized as a species at all, it is a "small" species close to *T. ruralis*.

21. Tortula norvegica (Web. & Mohr) Wahlenb. in Lindb. de Tort. 245. 1864.

Barbula norvegica Lindb. Öfvers. Vet.-Akad. Förh. **20**: 387. 1863.
B. aciphylla Bry. Eur. Mon. 42. 1842.
Tortula aciphylla Hartm. Skand. Fl. (Ed. V) 381. 1849.
Barbula brachyangia C. Müll. & Kindb. in Macoun, Cat. Canad. Pl. **6**: 59. 1892.
Tortula brachyangia Broth. in Engler & Prantl, Nat. Pflanzenfam. **1** (3): 435. 1902.
Barbula rufipila Card. & Thér. Bot. Gaz. **30**: 123. 1900.
Tortula rufipilis Broth. in Engler & Prantl, Nat. Pflanzenfam. **1** (3): 435. 1902.

Plants in dense tufts, green above, reddish-brown below; stems without central strand, loosely tomentose, 2–10 cm. long, branching dichotomously and through innovations; leaves squarrose-recurved from an appressed base, especially at the apex of the stem when moist, appressed, infolded, and slightly twisted when dry, oblong-elliptical to ovate-lanceolate, more or less acute; margin narrowly revolute from the base to or

slightly above the middle; costa brownish-red, spinose to verruculose-papillose on the back, excurrent into a long, reddish awn, which varies from nearly smooth to serrate, but usually less rough than in *T. ruralis*. Upper leaf cells as in *T. ruralis*, nearly all the basal cells hyaline, without a differentiated margin, becoming darker with age. Dioicous. Seta 1–2 cm. long, capsule erect, short-cylindric, the urn about 3 mm. long, straight, operculum long and narrowly conic, acute, more than half the length of the urn; annulus of 2–3 rows of cells, persistent, at least in part; basal tube of the peristome pale, nearly as long as the yellowish-red, papillose, much twisted teeth; spores 10–15 μ in diameter, smooth, ripening in summer. Type locality, Europe.

Illustrations:—Broth. Laubm. Fennosk. *fig. 29A–D;* Bry. Eur. *pl. 165;* Dixon, Handb. Brit. Mosses (Ed. III) *pl. 26D;* Husnot, Musc. Gall. *pl. 33, figs. 1–3;* Mönkemeyer, Laubm. Eur. *fig. 65c;* DeNot. Musci Ital. *pl. 16, figs. 1–12;* Roth, Eur. Laubm. *pl. 25, fig. 6a–c; Pl. 116.*

Exsiccati:—Macoun, Canad. Musci 82 (as *Barbula ruralis*), 221 (as *Barbula*), 222a (as *Barbula pseudaciphylla*), 479 (as *Barbula aciphylla*), Canad. Mosses 64a (as *T. papillinervis*), 65a.

An arctic and alpine species; on rocks and thin soil covering rocks from Greenland, across the American Arctic Archipelago, to Alaska, south in the Rocky Mountains into the western United States.

This moss, although intergrading to some extent with *T. ruralis*, and considered by some to be only a variety of it, is not difficult to distinguish, through the much less revolute upper leaf margins, the red, smoother excurrent costa, and the restricted range.

22. Tortula obtusissima (C. Müll.) Mitt. Journ. Linn. Soc., **12**: 174. 1869.

Barbula obtusissima C. Müll. Syn. Musc. **1**: 640. 1849.

Plants densely caespitose, bright glaucous green, rarely brownish or reddish, appearing hoary from the long hyaline leaf awns which all lie parallel in curious brushes or tufts in dry plants; stems without a central strand, loosely tomentose, short, to 2 cm., branching dichotomous; leaves appressed, sharply carinate and plicate when dry, closely twisted around the apex of the stem in a very characteristic manner when dry, widely spreading but not squarrose when moist, often showing clearly an arrangement in spiral rows, oblong to obovate, deeply concave, somewhat cucullate, the borders of the widely inflexed upper leaf margins sometimes touching, making the leaf tubular, even when moist, very obtuse, emarginate or retuse at the apex, the blade 3–4 mm. long; margin narrowly revolute nearly to the apex, not bordered in any way; costa red, thick, suddenly excurrent into a hyaline, extremely serrate and spinose roughened awn usually longer than the leaf itself, 3.5–5.0 mm. long, in cross section showing 2–4 very large median guide cells, 1 or 2 rows of large ventral cells, and a massive dorsal band of stereids whose outer layer is not differentiated, except for papillae; upper leaf cells larger than in *T. ruralis*, 16–24 μ in diameter, mamillose and densely spinose- and verrucose-papillose; thin-walled, basal cells much larger, hyaline, narrow at the margins. Dioicous. Seta short, stout, red, 10–14 mm. long; capsule erect, the urn straight or curved, long-cylindric, tapering to the mouth, about 3 mm. long; operculum long-conic, to 2 mm. long; peristome as in *T. ruralis*. Type locality, Mexico.

Illustrations:—*Pl. 115.*

Mr. Bartram, in reporting this species for the first time from our range, from Texas, says (Bryologist **32**: 8): "The robust habit, widely spreading (not squarrose-recurved) leaves when moist, emarginate apex and large verrucose-papillose upper leaf cells are characters which, in the aggregate, distinguish this plant from the ubiquitous *T. ruralis*. This collection agrees in every essential particular with specimens from Mexico and is of uncommon interest as representing the first record for the species in the United States." In running over a large series of specimens from several herbaria, I have recognized about a dozen additional collections, labelled "*T. ruralis*" or "*T. intermedia*," which extend the known range in the United States to Arizona (*Leiberg* 1062), Nevada (*Griffiths & Morris* 44), and California (*Bolander* 82; *Howe*, Musci Calif. 7).

23. Tortula princeps DeNot. Syll. Musc. Ital. 170. 1838.

Barbula Muelleri Bruch, Bryol. Eur. Mon. 44. 1842.
B. princeps C. Müll. Syn. Musc. **1**: 636. 1849.
Tortula Muelleri Wils. Bryol. Brit. 134. 1855.
Syntrichia princeps Mitt. Journ. Linn. Soc., Bot. **1** (suppl.): 39. 1859.

Plants in dense, wide tufts or mats, greenish- to brownish-red; stems without central strand, with an abundant reddish tomentum, especially in the leaf axils, 2–10 cm. high, branching dichotomously and by innovations; leaves crowded and larger at the apex of the stem, typically in interrupted or verticillate

rosulate tufts along the stem, erect-spreading, reflexed only at the apex when moist, appressed, slightly infolded and little twisted when dry, even at the apex of the stem; upper, larger leaves 2–5 mm. long, broadly lingulate or spatulate, concave, obtusely acute, rounded, or rarely emarginate at the apex; margin narrowly revolute in the lower half or two-thirds of the leaf; costa thick, very rough on the back, red, abruptly excurrent into a long, usually hyaline, serrate awn, in cross section showing 2 median guides, 2–3 layers of ventral cells, and a thick dorsal stereid band whose outermost cells are not differentiated; upper leaf cells green, densely papillose, quadrate, 12–14 μ in diameter, the basal cells rectangular, hyaline or somewhat reddish. Polygamous or synoicous. Seta 1–3 cm. long, red; capsule erect, cylindric, urn straight or somewhat curved, to 6 mm. long, reddish-brown, becoming darker and irregularly striate when old; operculum long-conic, about half as long as the urn, its cell rows twisted several times; annulus of 1–3 rows, persistent; basal tube of the peristome pale reddish, becoming pure white when old, obliquely tessellate, as long as the papillose teeth, which are twisted about two full turns; spores 10–15 μ in diameter, yellowish-green, smooth, ripening in spring. Type locality, Sardinia.

Illustrations:—Bartram, Hawaiian Mosses, *fig. 64;* Braithw. Brit. Moss-Fl. **1**: *pl. 33C, figs. 1–7;* Bryol. Eur. *pl. 168;* Dixon, Handb. Brit. Mosses (Ed. III) *pl. 26E;* Husnot, Musc. Gall. *pl. 34, figs. 1–9;* Mönkemeyer, Laubm. Eur. *fig. 65e;* DeNot. Musci Ital. *pl. 13, fig. 1–16;* Roth, Eur. Laubm. *pl. 25, fig. 1a–d;* Sim, Bryophytes of So. Africa, p. 226; Wilson, Bryol. Brit. *pl. 44; Pl. 116.*

Exsiccati:—Sull. & Lesq. Musci Bor. Am. (Ed. I) 100b, (Ed. II) 147 (as *Barbula*); Lesq. Calif. Mosses 147; Ren. & Card. Musci Am. Sept. 26 (as *Barbula*); Baker, Pacific Slope Bryoph. 682 (as *Barbula ruralis*), Suppl. Plants Pacific Coast 3644; Heller, Plants of Calif. 7259, 7252, 5204 (as *Barbula*), 7244 (as *Barbula laevipila*); Allen, Mosses of Cascade Mts. 21; Macoun, Canad. Musci, 80, 83 (in part), 230 (as *Barbula*), 74 (as *Barbula laevipila*), 223 (as *Barbula megalocarpa*), 221 (as *Barbula norvegica*), Canad. Mosses 81 (as *T. megalocarpa*), 443 (as *Barbula*), Canad. Crypt. 23 (as *Barbula alpina*), Flora Canad. 2096 (as *Barbula*); Holz. Mosses of Colo. 13; Musci Acro. Bor. Am. 234 (as *T. aciphylla*), 449, 650; Grout, Musci Perf. 267.

On soil and rocks, apparently both common and abundant on the Pacific Slope from Mexico to southern Alaska, extending eastward in the Rocky Mountains to Idaho (Leiberg 145) but not nearly as common there as the many reports, based on erroneous identifications, might indicate.

This species is very distinct from *T. ruralis*, yet is very commonly confused with it. The leaves are disposed in interrupted, verticillate whorls along the stem, nearly plane when dry, not infolded lengthwise, and spreading when moist, never squarrose-recurved. The leaf margin is not quite so revolute as in *T. ruralis*, although this is not a very clear cut distinction in our range. The most final and convincing feature of *T. princeps* for identification is the presence on nearly all fertile plants of the characteristic synoicous inflorescence. Even when the antheridia have weathered away and disappear completely, the bundle of paraphyses usually persists. However, the antheridia are apparently produced continuously for two whole seasons in some plants; at least I have often found mature antheridia which have not yet opened, as well as more immature stages at the base of one year old sporophytes. As some of the "flowers" contain only archegonia, and are apt to give a false impression of a dioicous plant, it is wise to examine several "flowers" before calling the plant *T. ruralis*, which is very rare on the Pacific slope, being replaced in large part by the present species.

Excluded Species

The following species, although well known and of wide distribution in Europe, do not seem to be members of the North American flora, as all reports of them in our range are apparently based on misidentifications: *Tortula alpina* (Bry. eur.) Bruch, *Tortula canescens* (Bruch) Mont., *Tortula cuneifolia* (Dicks.) Roth, *Tortula laevipilaeformis* DeNot., *Tortula marginata* (Bry. eur.) Spruce, and *Tortula Vahliana* (Schultz) DeNot.

The following are rejected for the reasons given:

1. *Tortula astoriensis* Broth. in Röll, Abh. d. Naturw. Ver. Bremen **14**: 193. 1897. I can find no description for this name, the type specimen cannot be found in Brotherus' Herbarium (*fide* Dr. Harald Lindberg, *in litt.*), and Brotherus does not include it in either edition of his Musci in Engler & Prantl. It is apparently a *nomen nudum.*

2. *Barbula carnifolia* C. Müll. & Kindb. in Macoun, Cat. Canad. Pl. **6**: 52. 1892. The original material of this species cannot be found either at Stockholm or at Ottawa, and Kindberg himself soon abandoned the name. Consequently, it must be rejected as a *nomen dubium.*

3. *Tortula Egelingii* (Schlieph.) Broth. in Engler & Prantl, Nat. Pflanzenfam. **1** (3): 430. 1902. A small fragment of the type specimen, which agrees well with the original description, has been seen. It is certainly *Desmatodon Porteri* James.

4. *Barbula latoexcisa* C. Müll. & Kindb. in Macoun, Cat. Canad. Pl. **6**: 60. 1892. Most of the original material of this species, which Kindberg later placed in synonymy under *Tortula pulvinata* Jur., seems to be *T. princeps.*

5. *Barbula papillinervis* C. Müll. & Kindb. in Macoun, Cat. Canad. Pl. **6**: 60. Although Kindberg later considered this to be a subspecies of *Tortula pulvinata*, none of the various specimens cited in the original description are that species, which apparently does not occur in our range. Since the different collections upon which the species was based actually represent several different species, including *Barbula cylindrica*, *Tortula ruralis*, *T. norvegica*, and *T. intermedia*, the name should be rejected as a *nomen dubium*.

6. *Tortula pseudoaciphylla* (Kindb.) Broth. in Engler & Prantl, Nat. Pflanzenfam. **1** (3): 435. 1902. The history of this species is so complex, and so many different species are involved in the supposed type material that the name should be rejected. The species was based on two of Röll's specimens which had been previously identified as *T. intermedia*, yet the Canadian specimens identified by Kindberg as *T. pseudoaciphylla* are a series of several species, none of them *T. intermedia!*

7. *Tortula rotundoemarginata* (C. Müll. & Kindb.) Broth. in Engler & Prantl, Nat. Pflanzenfam. **1** (3): 435. 1902. Most of the specimens so-named, both in Kindberg's Herbarium and in Macoun's Herbarium, are actually *T. intermedia*.

8. *Tortula submegalocarpa* (Kindb.) Broth. in Engler & Prantl, Nat. Pflanzenfam. **1** (3): 435. 1902. Since the specimens so-identified by Kindberg are in large part *T. ruralis* and *T. princeps*, but also include other species, the name should be rejected as a *nomen dubium*.

11. MERCEYA Schimp. Syn. (Ed. 2). 852. 1876.

Scopelophila Spruce, Jour. Bot. No. 217. 1881.

Plants in loose or dense tufts; stems branched, erect, 1–5 cm. high, obscurely 5-angled, without central strand; leaves oblong to ligulate, obtuse or bluntly pointed, costa ending below the apex; margin bordered by 3–7 rows of thickened and enlarged cells which are frequently colored; upper median leaf cells quadrate to oblong, faintly papillose or apparently smooth, basal cells becoming enlarged, oblong, usually thin-walled or inflated. In cross section the costa shows 1–2 rows of enlarged thin-walled cells on the ventral (upper) side, the main portion within is a stereid tissue bordered on the dorsal side by cells slightly larger and less thickened; in section the thickened leaf margin is clavate in outline, the cells thick-walled and often colored; dioicous; perigonium terminal, orange-yellow, paraphyses numerous; fruit unknown.

The systematic position of this genus is not well established since the sporophyte has never been observed. The structure of the stem and leaves relates it to both *Tortulaceae* and *Encalyptaceae*, and it has been placed in each of these families by various authors.

Key.

Plants small, slender; leaves 2–3 mm. long, erect to patent; upper leaf cells mostly quadrate 10–15 μ in diameter ..... *1. ligulata.*

Plants large, robust; leaves 3–5 mm. long, patent to spreading; upper leaf cells mostly hexagonal, 18–26 μ in diameter ..... *2. latifolia.*

1. MERCEYA LIGULATA (Spruce) Schimp. l. c.

Encalypta ? ligulata Spruce. Musci Pyren. No. 331. 1845; Trans. Bot. Soc. 3^3: 187. 1850.
Zygodon ligulatus C. Müll. Syn. **2**: 636. 1851.
Weisia ligulata Mitt. Jour. Linn. Soc. **12**: 135. 1869.
Scopelophila ligulata Spruce, Jour. Bot. New Series. **10**: 12. 1881.

Plants in compact tufts up to 4 cm. or more high; stems slender, branched, green at the tips, reddish or dark brown below, radiculose; leaves ligulate to oblong, spatulate, 1–1.5 mm. long, broadest near the apex, base oblong and narrowed, apex bluntly pointed or obtuse, somewhat concave to keeled, occasionally mucronate, comal leaves acute or obtuse, costa ending below the tip or nearly percurrent, in cross section semilunar, mostly slender, prominent at the back (weak in North American plants) *with a single row of large ventral cells;* margins entire, plane or slightly recurved below, thickened in older leaves; median upper cells quadrate to oblong or irregular, 10–15 μ, apparently smooth or with low convex papillae, marginal cells frequently transversely elongated and in some older leaves marginal cells enlarged, thick-walled; basal cells larger, up to 18 x 45 μ, oblong, usually thin-walled or inflated, marginal row narrower, linear, thicker-walled, in older leaves the basal cells are frequently thick-walled. Dioicous. Perigonium terminal; sterile except a few shrunken archegonia. Type locality European.

ILLUSTRATIONS:—Husnot, Musc. Gall. *pl. 79;* Limpr. Laubm. **2:** 124. *f. 249; Pl. 120.*
EXSICCATI:—Sharp, 34287; and Bryophytes of Eastern U. S. 183; Grout, Musci Perf. 256.
A rare plant in North America. A. J. Sharp collected it on moist shaded rocks in the Great Smoky Mountains of Tennessee. The plant compares very favorably with European specimens. The costa is not as stout nor as prominent at the back as Limpricht shows. The thickened border is not evident in the upper green leaves but in the older colored leaves the marginal cells become thickened and in cross section the lamina is clavate at the margin. The cells of the extreme outer margin are smaller.

1a. Var. BARTRAMII E. Bauer, Musci Eur. & Am. 1834. 1925.

Differs from the species in the more slender and lax habit, the leaves narrower, the lower half or two-thirds of enlarged lax cells, the costa very weak, not prominent at the back. Upper medial cells 7–8 μ, quadrate to oblong; basal cells very large, up to 22 × 55 μ, thin-walled and often inflated. Type locality, Flux Canyon, Patagonia Mountains, Santa Cruz Co., Arizona.

ILLUSTRATIONS:—*Pl. 120.*
EXSICCATI:—Holzinger, Musci Acro. Bor. Am. 546; Bartr. Mosses of S. Arizona 124; E. Bauer, Musci Eur. & Am. 1834.
E. B. Bartram collected this variety on ledges in a stream bed. It seems to be like other members of the genus with respect to habitat.

2. MERCEYA LATIFOLIA Kindb. Bull Torr. Club **16:** 94. 1889; Macoun Cat. Can. Pl. **6:** 97. 1892.

Plants in loose or dense tufts, rather coarse, dark green, often tinged with red. Stems branched, 2–5 cm. high, radiculose and reddish below, naked or with older leaf bases and costae adhering, apex of branches with a tuft of green leaves, usually tinged with reddish or orange color and frequently encrusted with mineral deposit; leaves slightly crisped or curved when dry, not greatly altered, patent to spreading when moist, often forming a terminal rosette, broadly spatulate or ligulate, a few oblong, 3.5–5 mm. long, base narrower, gradually increasing in width upward, apex broad and rounded, tip with a short mucro which may be blunt or pointed; costa stout, prominent at the back, percurrent or forming the mucro, yellowish or reddish, in cross section semilunate *with two rows of thin-walled ventral (upper) cells* and a large area of central stereids, dorsal cells of a single layer, thin-walled or often rather thick and not strongly differentiated from the small stereids; margins *bordered with 3–7 rows of orange-colored, thick-walled and* enlarged cells, slightly recurved, revolute at the base; upper median cells quadrate to oblong or hexagonal, *18–26* μ wide and up to 38 μ long, marginal cells enlarged, thick-walled, rounded, oval or oblong, the extreme marginal row very much smaller, 6–8 μ wide, in cross section the lamina is clavate in outline at the margin; basal cells becoming larger, oblong 18–30 μ wide and up to 95 μ long, thin-walled, often inflated, marginal ones narrower, linear, walls thicker, often colored; papillae evident on the upper cells, usually low and simple, occasionally rather strong. Dioicous. Flowers not seen, fruit unknown. Type locality in British Columbia (Vancouver Id., May 18, 1887, probably the type collection).

ILLUSTRATIONS:—Williams, Bull. N. Y. Bot. Gard. **2:** *pl. 37; Pl. 120.*
EXSICCATI:—Flowers, Mosses of Utah 26; Macoun, Can. Musci 459.
On damp soil and rock, especially bordering streams and sometimes submerged in the swift current. British Columbia, California, Utah, Colorado and Montana.
This plant is rather rare but plentiful in local regions. It is abundant in certain canyons in Utah where Dr. Flowers has seen it growing in dense masses along dashing streams and even submerged in the swift current. It was noted that plants growing on the wet rocks away from the spray exhibit the orange-colored border on the leaves more strongly than is the case in plants growing in the spray, while in plants growing in the water it is usually lacking. Also, the submerged plants are brighter green and the stems are not as naked as in aerial forms. Just how the plant multiplies is not definitely known but in the course of examining specimens a structure was observed which strongly resembled a bulbil. Being detached and a similar structure not being observed in actual position on the plant, the validity of the observation is questionable. Certain rhizoids approach the form of brood bodies, but in no case were any seen which could be definitely associated with such structures.* The leaf cells average twice as large as in *M. ligulata* and smooth or *slightly papillose* on the more conspicuous border cells.

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* Acknowledgments are made to Dr. Flowers for collaboration in the preparation of the manuscript on *Merceya*.

12. BRYOBRITTONIA Williams, Bull. N. Y. Bot. Gard. **2**[6]: 115. 1901.

Plants with costal structure like the Pottieae, and mamillose cells much like the upper layer of cells in *Timmia*, but unistratose and mamillose on both faces. The soft texture of the leaves and the paraphysis-like hairs in the leaf axils suggest the *Splachnaceae*. Its true relationships will remain obscure until capsules are found.

BRYOBRITTONIA PELLUCIDA Williams, l. c.

Stems mostly simple, in loose tufts up to 2 cm. high; central strand present, distinct, of numerous small thin-walled cells; comal leaves much the largest, often inclosing numerous long paraphysis-like hairs, oblong-lanceolate to subspatulate, widest above the middle, up to 7.5 x 1.5 mm., more or less shriveled and contorted when dry, obtuse to obtusely acute; margins plane, crenulate-serrate above by projecting cell angles; costa strong, ending several cells below the apex, in cross section with median guides and 2–3 rows of cells nearly as large on the ventral side and a dorsal stereid band bordered on the dorsal surface by a row of slightly larger cells; upper leaf cells rhomboidal to hexagonal, 15–20 μ in longest dimension, strongly mamillose on both faces; basal cells smooth, elongate rectangular, those near the costa up to 20–30 x 100 μ or more, those at the margins narrower, 4–6 mm. wide and running up the margin beyond the area of short mamillose cells. Antheridia and archegonia unknown. Type locality, Yukon River just below Dawson on rock, April 6, 1899, no. 587 (Williams). Type examined.

ILLUSTRATIONS:—Williams, l. c. *pl. 16; Pl. 109.*
The above description adapted from the original by Williams.

CINCLIDOTUS FONTINALOIDES (Hedw.) P. B.

This species was reported from Ontario by Macoun in the Lesq. & James Manual p. 134, but no North American specimens can be found at The Canadian National Museum at Ottawa, at the U. S. National Museum, The New York Botanical Garden or at the Farlow Herbarium of Harvard. It seems pretty certain that Macoun's record was due to an error in determination.

ADDITIONS AND CORRECTIONS

FISSIDENS MINUTULUS f. AUSTRALIS **n. f.**

Cellulae foliorum 7–8 μ; margine laminae dorsalis in parte inferiore evanido.

Leaf cells mostly obscure, bulging, mostly 7–8 μ in diameter; border narrow, often vanishing on the lower ½ of the dorsal lamina. N. Carolina (*Anderson*, no. 2691; *Bevan*, 466 & 611; Georgia, *Small*, 9137).

FISSIDENS RADICANS Mont. Ann. Soc. Nat. Ser. 2, **14**: 345. 1840.

Fissidens flavicans Schimp. in Herb. Kew (according to Salmon, Ann. Bot. **13**: 125. 1899).
Fissidens Smallii E. G. Britton in Herb. N. Y. Bot. Garden.

Close to *F. Donnellii*, distinguished as follows:—The plants are a little larger as a rule, more often branching by innovations; the leaves narrowly oblong and of nearly uniform width until near the obtuse apex; leaf cells more regular, smaller, rarely over 8 μ, less angular, mamillose-bulging rather than papillose; marginal cells smaller and less acute, not more strongly crenulate on the vaginant laminae than near the apex. Sporophyte terminal or occasionally on a short lateral branch. Type locality, French Guiana. *Pl. 122.*

My attention was called to this species by Mr. Bartram, who sent me a specimen from Royal Palm Park, Florida, collected by Small and others (no. 7191, which Mrs. Britton had called as an herbarium name, *F. Smallii*). This is the same as the specimen from Coconut Grove mentioned on p. 18 of this volume. It has also been collected at Deering Hammock near Miami by Mrs. Britton and in Costello Hammock, Dade Co., Fla. by McFarlin; Manatee, Fla. (*Grout*). It is found on rotten wood and limestone southwards to Brazil. Mr. Bartram is responsible for identifying the Florida moss with *F. radicans*. The illustrations of the leaves of *F. Donnellii* (*Pl. 10*) show leaves almost exactly the outline of *F. radicans*. Most of the leaves of *F. Donnellii* are gradually narrowed above and acute, as Mrs. Britton describes them. In *F. radicans* the leaves are of a nearly uniform width until they are usually abruptly "pinched" off to the narrower obtuse apex. However, the much more coarsely toothed vaginant laminae of *F. Donnellii*, especially on the perichaetial leaves, is well shown in *Pl. 10, f. 6.*

Fissidens Littlei (Williams) n. comb.

Moenkemeyera Littlei Williams, Bryol. **39**: 40. *pl. 4*. Sept. 30, 1936.
Fissidens Orcutti Grout, Moss Fl. N. Am. **1**: 20. Oct. 23, 1936. (Which see.)

Peristome teeth undivided, from a short basal membrane, warty-papillose; spores about 8 μ, mature in spring. Type locality, vertical shaded walls of gypsum sink, two to four feet below the general surface of gypsum deposits a mile or so north of Middle Well, alt. 4200 ft., New Mexico (*E. L. Little*, no. 108, June 9, 1935).

Specimens from the type locality have been studied through the courtesy of Mr. Little.

The only distinction between *Fissidens* and *Moenkemeyera* is the undivided teeth of the latter. Undivided teeth are found in the subgenus *Octodiceras* (*F. Hallianus*), and in the section *Sublimbati*, and in this species with wholly unbordered leaves. Thus the undivided peristome teeth occur in such varied parts of the genus that it seems better to leave such species in *Fissidens*, rather than erect a parallel. *Littlei* will key out to *Orcutti* in the key, Vol. **1**, p. 8.

Fissidens Neoni (Bartr.) n. comb.

Moenkemeyera Neoni Bartr. Bryol. **34**: 77. 1931.

Plants minute, dull yellowish green, closely gregarious, radiculose at base, male and female plants matted together; stems of fruiting plants about 1 mm. high, imbedded in the soil, bearing 3–4 pairs of leaves; lower leaves very small, with vaginant laminae only; upper leaves abruptly larger, ovate to broadly lanceolate, 0.6–0.8 mm. long; vaginant laminae extending about $\frac{4}{5}$ the way to the apex; dorsal lamina ending about half way down in the broader leaves, in some of the narrower leaves reaching nearly to the insertion; perichaetial pair of leaves larger, reaching 1 mm. in length; margins slightly crenulate; costa percurrent or ending just below the apex; leaf cells rhomboidal and hexagonal, 8–10 μ in diameter, smooth; margins of the vaginant laminae and frequently median margin of dorsal lamina bordered by narrowly linear cells; apical margins not bordered; sterile stems simple or branched, 3–4 mm. long, with leaves 0.8 mm. wide, bearing 10–20 pairs of leaves, which are oblong-ovate, 0.5 mm. long with border usually distinct on the vaginant laminae. Dioicous; male plant bearing a few antheridia enclosed by 3–4 laxly areolate concave perigonial leaves, which are broadly notched at the apex of the vaginant laminae; seta terminal, reddish, 2.5–3 mm. long; capsule erect, oblong-cylindric, up to 1.5 mm. long by 0.5 mm. broad, contracted under the mouth when dry; peristome teeth 16, not divided, erect-spreading when dry, strongly incurved when moist, nearly smooth below, papillose in the upper part, not striate, fragile; operculum conic-rostrate, erect; calyptra very small and fugacious; spores minutely papillose, 20–25 μ in diameter. Type locality, vicinity of Lafayette, Louisiana, March 30, 1931 (Bro. *Néon*, no. 885).

Description adapted from the original. This species will key out to *F. Ravenelii* in the key on p. 9 from which it is distinguished by its smooth leaves and undivided peristome teeth.

Illustrations:—Bryol. l. c. *pl. 5; Pl. 121B.*

Campylopus carolinae n. sp.

Plantae minimae, 1–2 cm. altae; folia inferiora minora; folia superiora 4–6 mm. longa, maxime varia, ad basin ovata vel oblanceolata, ad apicem lineare-lanceolata serrataque; costa longe excurrente, saepe perlucida in parte superiore.

Plants small, mostly under 2 cm., lower leaves smaller and more appressed, the comal longer and more spreading when dry, reaching 6 mm. or more in length, as a whole most variable even on the same plant, very concave, subtubular above, some narrowly lanceolate and evenly narrowed to the slender toothed awn, with costa nearly $\frac{1}{3}$ the width at the base, and alar cells inflated forming auricles, others lance-subulate from an oblong-ovate base with costa only 1/7–1/8 the width of the leaf at base and alar cells not inflated or differentiated; basal cells long-rectangular about 15 x 45–75 μ, hyaline, gradually changing upwards to the cells of upper base, which are mostly rounded and oblong, rectangular, or rhomboidal, 2–3 : 1, in the narrower lamina above 2–4 : 1 and *flexuose;* costa *long-excurrent into a slender toothed awn which may be* $\frac{1}{3}$ *the length of the leaf and often decolored and hyaline in the upper portion, in cross section with a central row of guides and a narrow band of stereids dorsally and ventrally much as* in *C. brevipilus* Bry. Eur. (*plate 43*), *no larger cells on the ventral surface, a few cells smaller than the guides but much larger than the stereids interspersed on the*

dorsal side much as shown in C. fragilis (*pl. 48*). Only sterile plants known. Type locality, sandy soil near Southport, N. Carolina, March 27, 1938 (*L. E. Anderson & A. W. Evans*, no. 6180). *Pl. 122.*

Clearly a close relative of the European *C. brevipilus* and resembling it in many particulars, but the dorsal and ventral surface cells of the costa are quite different, the toothed awn is much longer, and only occasionally hyaline and the leaf margins are serrulate some distance below the excurrent costa.

SYRRHOPODON GAUDICHAUDII Mont. Ann. Sci. Nat. II. **2**: 366. *pl. 16, f. 3.* 1845.

Plants in compact green tufts, showing the conspicuously white leaf bases; stems branching, 1–3 cm. high; stem leaves more or less twisted and crispate when dry, from an obovate or oblanceolate erect base narrowed to a linear-lanceolate deeply grooved point once or twice the length of the base, nearly or quite entire except at the broadly acute denticulate apex, bordered by a mostly cylindric band of stereid cells extending from or near the apex to the basal part; costa not quite percurrent, smooth on both sides except at the denticulate apex, about 1/6 the width of the leaf at the middle, in cross section with a row of about 4 median guides with a stereid band on each side, the dorsal much the larger, outer cells not differentiated; cells of the upper part of the leaf rather obscure, about 6 μ in diameter, densely papillose on both sides; cancellinae filling most of the basal part of the leaf, somewhat rounded or truncate above; outer perichaetial leaves little different, the 2–3 inner much smaller, of mostly hyaline cells, often slightly serrulate. Dioicous; male plants about like the fertile, often with several antheridial buds aggregated near the apex of the stem, antheridia few, without paraphyses, enclosed by several short ovate leaves which are brownish, costate and serrulate; seta up to 6 mm., not quite smooth above; capsule erect, oblong, urn scarcely 1.5 mm. long; operculum convex-conical and rostrate, about 1 mm. long; peristome teeth golden brown, not quite smooth, lanceolate, entire, projecting about 80 μ above the rim of the capsule, with rather prominent articulations; spores rough, 12–14 μ in diameter. Type locality, Isle of St. Catherine, Brazil.

ILLUSTRATIONS:—Mont. l. c.; Williams, Bull. Torr. Club **47**: *pl. 15, f. 7; Pl. 121.*

Highlands Hammock, Sebring, Florida (J. B. McFarlin), sterile plants only. The description is copied from that of Williams, Bull. Torr. Club **47**: 374. 1920.

In the Key, p. 129, this will key out to *S. texanus*, from which it is easily distinguished by the margin entire except at apex.

CALLIERGON WICKESII **n. sp.**

Plantae minimae; folia caulis oblonga vel obovata, 1–1.6 mm. longa; costa valida, in folia superiora longitudine ¾ foliorum; cellulae mediae lineare-flexuosae, 60 μ longae.

Plants small, intertangled with other hydrophytic mosses; stems julaceus with the appressed leaves when dry, sparingly branched; upper oblong, apiculate, often cucullate with incurved apiculus, reaching 1.6 mm. in length, the lower obovate and broadly obtuse, shorter, mostly not apiculate or cucullate; costa strong in the upper leaves, reaching about ¾ the length of the leaves, shorter and sometimes forking in the lower leaves; median leaf cells linear-flexuose, reaching 60 μ in length, in the older leaves incrassate with lumen little wider than the somewhat porose cell walls; apical cells shorter and broader; the basal also shorter and broader, a few at the extreme angles somewhat inflated and becoming very thick-walled and colored with age. *Plate 124, fig. B.*

Type in herbarium of A. J. Grout. Type locality, Labrador (Wickes 1938).

Distinguished from *C. sarmentosum* by its broad short leaves, shorter costa and less differentiated alar cells. From *C. stramineum* by the relatively broader and more concave apiculate leaves.

CORRECTIONS TO VOL. I.

P. 4. Dr. H. S. Conard calls attention to the fact that in *Andreaea crassinervia* the costa is wide and gradually merges into the lamina while in *Rothii* it is marked off into a distinct subcylindric ridge.

P. 14. A specimen of *Fissidens sublimbatus* from Columbia, Missouri (*Drew*) has leaves more acute than in the type, cells of vaginant lamina larger and not in distinct rows; operculum more longly rostrate.

P. 14. Also *Fissidens exiguus* has been collected in Reynolds Co., Mo. (*Drew*).

P. 16. *Fissidens obtusifolius kansanus*, Cumberland Falls, Kentucky (*Welch*).

P. 17. *Fissidens Garberi*, Fayette, Wisconsin (*Cheney* 1891); the illustration is *plate 7A*, not *15A*.

P. 23. Lines 7 and 11 from bottom, *F. Julianus* instead of *F. fontanus*.

P. 24. Dr. T. C. Frye reports that A. S. Foster collected *Bryoxiphium norvegicum* on Mt. Rainier.

P. 45. The seta of *Ditrichum ambiguum* is sometimes yellow or orange when young.

P. 47. The report of *Ditrichum giganteum* from Michigan seems to be an error.

P. 55. *Dicranella Grevilleana* occurs in Keweenaw Co., Michigan (see Rhodora 1937, p. 39).

P. 67. *Oncophorus polycarpus strumiferus*, near summit of Mt. Monadnock, New Hampshire; Catskill Mts., N. Y. (Mrs. Inez M. Haring).

P. 69. *Oncophorus Schisti*, Keweenaw Peninsula, Michigan (Steere).

P. 73. *Dicranoweisia crispula*, Mt. Washington, New Hampshire.

P. 81. The capsules of *Dicranum fuscescens* are sometimes slightly strumose.

P. 101. Type species of *Atrichum*, *A. undulatum* (Hedw.) P. B.

P. 101. *Atrichum crispum:* Sull. & Lesq. Musci Bor. Amer. 315.

P. 102. *A. undulatum:* Sull. & Lesq. Musci. Bor. Amer. 313; the var. *Selwyni*, Drumm. Musci Amer. 66 (as *Polytrichum undulatum*).

P. 104. *A. angustatum:* Drumm. Musci Amer. 285 (one package almost pure, another about half *A. angustatum* and half *A. undulatum*), Macoun 215; Sull. Musci Allegh. 118, Sull. & Lesq. 314.

P. 105. *A. papillosum* is a synonym of *A. Macmillai*, Vermont (Grout); common, S. Atlantic States.

P. 107. *Oligotrichum parallelum:* Leiberg & Sandberg West Amer. plants 867 (as *Atrichum parallelum*).

P. 108. *O. aligerum:* Drumm. Musci Amer. 448 (as *Polytrichum hercynicum*); Mosses of Harriman Alaska Exped. 658.

P. 114. *Pogonatum pensilvanicum:* Sull. Musci Allegh. 116 (as *P. brevicaule*), Sull. & Lesq. 316 (as *P. brevicaule*).

P. 115. *P. brachyphyllum:* Sull. Musci Allegh. 117, Sull. & Lesq. 211, 217; north to Connecticut and Long Island, N. Y.

P. 115. *P. contortum:* Macoun 220 (as *P. alpinum*).

P. 116. *P. urnigerum:* Sull. Musci Allegh. 114, Sull. & Lesq. 319.

P. 117. *P. capillare:* Sull. Musci Allegh. 115 (as *Polytrichum capillare*), Sull. & Lesq. 318; Connecticut, New Jersey, Michigan as *P. alpinum*, Connecticut (See Evans and Nichols, Bryoph. Ct.).

P. 121. *Polytrichum gracile:* Sull. & Lesq. 324 (Exsiccati, omit 1106 in second line).

P. 122. *P. ohoiense:* Sull. Musci Allegh. 110 (as *P. formosum*).

P. 124. *P. commune:* Drumm. 72, 275 not 279, Macoun 225, Sull. Musci Allegh. 109, Sull. & Lesq. 329; the var. *perigoniale*, Sull. & Lesq. 330.

P. 125. *P. norvegicum:* Macoun 218 (as *Oligotrichum aligerum*), also 192a and 428 (both as *P. sexangulare*).

P. 126. *P. juniperinum:* Sull. Musci Allegh. 112; var. *alpestris*, Sull. Musci. Allegh. 113.

P. 128. *P. piliferum:* Macoun 222, Sull. Musci Allegh. 111, Sull. & Lesq. 325.

P. 131. *Syrrhopodon ligulatus*, Pensacola, Florida (McFarlin).

P. 141. *Encalpyta rhabdocarpa*, northern Michigan (*Nichols*); Arizona, Washington, Oregon.

P. 144. *E. procera*, northern Michigan (*Nichols*); Lockport, Illinois.

P. 145, line 38: *Encalypta streptocarpa* has also been reported from Lockport, Illinois. Its range extends from Labrador to North Carolina, Pennsylvania westward to northern Indiana, Illinois, and reaches its southwestern limit at Red Oak, Iowa. It extends across Canada to British Columbia and adjacent Washington, Idaho, Montana, and Minnesota.

P. 153. *Astomum phascoides* is *plate 82*, not *84*.

P. 155. *Weisia tortilis*, Ohio (*Sharp*).

P. 157. *Weisia jamaicensis*, *Pl. 82*, not *84*.

P. 158. Steere, Bryol. 42: 16–22, *plates* 1 and 2 1939. states that Drummond's Musc. Ann. 21 is true *Gymnostomum tenue* and that Moxley has collected it at Owen Sound, Ontario. It is further distinguished from *G. calcareum* by the lack of distinct stereid bands in its costa.

P. 159. Holz. Musc. Acro. Bor. Am. 331 not 311 ?

P. 166. *Tortella caespitosa* should be *T. humilis* (Hedw.) Jennings, Mosses W. Pennsylvania, 95. 1913.

P. 166. *Barbula humilis* Hedw. Sp. Musc. 116. 1801.

P. 167. *Tortella flavovirens* is *plate 78*, not *82*.

P. 188. *Didymodon rigidulus* Hedw. Tennessee (*Sharp*).

P. 191. Key to the *Trichostomeae* 11, *Barbula* is number 14, not 15. 15, second line should read, Leaves bi- tri-stratose *except* along the margins.

ADDITIONS AND CORRECTIONS TO VOL. III.

P. 22. *Eurhynchium riparioides* (Hedw.) Sharp, Bryol. **41**: 126. 1938, supersedes *E. rusciforme* (Neck.) Milde. (*Hypnum riparioides* Hedw. Sp. Musc. 242. 1801.)

P. 50. BRACHYTHECIUM CAVERNOSUM Kindb. (See Vol. III, p. 50.)

The illustration, *pl. 127*, was made from specimens collected by Brinkman at Glacier, British Columbia and identified by Kindberg himself. They agree with Kindberg's meager original description except as regards the basal and alar cells, which are likely to remain on the stem unless removed with considerable care.

The ovate and acuminate leaves are much like the stem leaves of *B. oxycladon* except that they are conspicuously decurrent with alar cells less numerous, considerably enlarged and oblong-hexagonal instead of small and quadrate. A row or two of these enlarged cells runs across the base of the leaf at the insertion. The cortical cells of the stem, often removed on the leaf base, are about the width of the median leaf cells.

The plicate leaves and different alar cells distinguish this species at once from *B. rutabulum;* the much less inflated and less numerous alar cells from *B. rivulare.* There were no sporophytes on the Brinkman plants but as Kindberg compared his fruiting plants with *B. rutabulum* and *B. rivulare*, the seta is probably rough. In that case it will key out to *B. lamprochryseum* or *B. asperrimum*, with which it is not likely to be confused.

BRACHYTHECIUM HOLZINGERI Grout (see Vol. III, p. 50).

Mr. A. H. Brinkman has sent me enough of his no. 325, the collection from Kamloops, British Columbia mentioned in the Bryologist **25**: 14. 1922, to use as no. 66 of my Musci Pleurocarpi Supplement.

In spite of my statements in Vol. III, p. 50, I am now convinced, after a careful comparison, that the Sperry Glacier plants (see Bryol. **4**: 48. 1901) are not typical of this species but are a poorly developed form of it. As these were described as a variety *B. collinum*, the Brinkman plants should be considered the type.

Dr. Flowers' illustration (*plate 129*) from the Kamloops plants are excellent and will give a better idea of the species than any description. From *B. collinum*, to which it will key out, and to which it is more closely related than any other American species, it is distinguished by its more robust size, larger and much more slenderly acuminate leaves, and more strongly papillose seta. Mrs. MacFadden has collected a more slender form of this species at Sandon, British Columbia (no. 696), Oct. 11, 1927.

P. 150. Type species of *Mittenothamnium* is *M. reptans* (Hedw.) Card.

P. 204. By agreement of the International Botanical Congress *Haplohymenium* is made a nomen conservandum with type species *H. triste* (Cesati) Kindb.

P. 205. Add to the footnote: sterile *Thuidium abietinum.*

P. 213. *Papillaria* has been made a nomen conservandum, hence *P. nigrescens* (Sw.) Jaegr. & Sauerb. supersedes *Tricholepis nigrescens* (Sw.) Grout.

P. 208. Type species of *Neckera* is *N. pennata* Hedw., not *N. crispa* Hedw.

This has no connection with Vol. III, but is a last minute addition.

FISSIDENS ANDERSONI **n. sp.**

Plantae 4–6 mm. altae; folia 6–8 juga, oblonga vel lanceolato-oblonga, 1.4 x 0.5 mm. acuta; lamina duplicaturae limbata; costa sub apice finiente; cellulae hexagonae, leves, 10–15 mm. latae; archegonia in apice caulis.

Plants up to 6 mm. long, rarely branching; leaves contorted to slightly crisped when dry, oblong to oblong-lanceolate, up to 1.4 x 0.5 mm., mostly smaller, abruptly to gradually acute, up to 8 or more pairs in number; vaginant laminae extending about ½ the length of the leaf; bordered in the fertile stems by a narrow band of 2–3 narrowly linear cells, which towards the leaf base are usually reduced to a single row inside of a row or two of quadrate marginal cells; dorsal and apical laminae not bordered; in some sterile plants the border is present in the upper leaves only; margins entire, without papillae; upper leaf cells hexagonal, somewhat irregular, 12–15 μ in diameter, smooth, sometimes somewhat bulging-mamillose; basal cells more elongate and rectangular; costa usually ending two or more cells below the apex but occasionally percurrent. Only undeveloped terminal archegonia found, with perichaetial leaves not fully developed.

Type from wet soil, floor of cypress swamp near Currituck, Currituck Co., N. Carolina, May 15, 1939, Lewis E. Anderson, no. 6505. Type in herb. Duke University, cotype in herb. A. J. G.

The larger smooth cells distinguish this species easily from *F. Ravenelii* and *F. Garberi*, which plainly show papillae along the marginal cells. The leaves of *F. Neoni* are entirely different, smaller, ovate, with elongate cells and border often found on dorsal lamina.

The plants have been checked against all the Mexican and West Indian plants reported in the second edition of Engler & Prantl, except those which Paris reports from "Guadalup" only.

The illustration of the border in the vaginant lamina of *F. sublimbatus*, though much stronger, illustrates the border in this species fairly well.

Ditrichum currituckI n. sp.

Plantae minimae; caulis 1–2 mm. altus; folia subulato-capillaria e basi lanceolata, 3–4 mm. longa; costa latissima, excurrens; seta 0.7–1 cm. longa; capsula ovata, 1 mm. longa deoperculata, annulata; dentes peristomii prope ad basin fissi, papillosissimi.

Plants small, yellowish-green; stems simple, 1–2 mm. long; *leaves long filiform-subulate* from a lanceolate base, up to 4 mm. long, channelled above, entire except at and near the apex, more or less secund especially at the stem ends, little changed in drying; costa very wide, up to ¾ the width of the leaf base and occupying nearly all the subula, long excurrent; basal leaf cells rectangular, 2–4 : 1, narrower at the margin, smaller above and about 5 μ wide; inner perichaetial leaves from an oblong sheathing base gradually narrowed to an even more filiform or capillary subula which is usually entire and much longer than the sheathing base, often only a single cell wide at the apex, basal cells of the sheathing portion oblong-hexagonal, slightly inflated, 75–120 x 20–25 μ. Seta reddish-yellow, up to 1 cm. long; capsule ovoid, largest in the middle, urn up to 1 mm. long, nearly or quite symmetric, often inclined, often showing a very slight struma, antheridia, calyptra and operculum not found; peristome of 32 filiform segments from a low papillose basal membrane, spinose-papillose as in *D. pallidum*, up to 180 μ long; annulus apparently of a single row of large cells, partially persistent in old capsules; *spores 22–25* μ, rough with coarse irregular papillae as in *D. pallidum*. Type locality, near Currituck, Currituck Co., North Carolina, May 13, 1939, L. E. Anderson and A. J. Grout. MF II Pl. 115

This species clearly belongs in the group with *D. pallidum* and *D. Schimperi*. From the former it differs in its smaller size, especially the shorter and less brilliantly yellow seta, and shorter unfurrowed capsule, which is only shrunken when dry and empty, in the much larger spores and wider costa. From the latter, while it has the large spores, it differs in the other particulars mentioned under *D. pallidum*, also in the teeth, as strongly papillose as in that species.

It is nearest of all to the European *D. subulatum* (Bruch) Hampe. From that it differs in its wider costa, leaves more gradually narrowed from the basal portion, more slender subula, well developed annulus of large cells and larger spores.

From the tropical *D. rufescens* (Hpe.) Broth. it differs in much the same particulars as from *D. pallidum*, also in the spores which in *D. rufescens* are smooth and 10–18 μ.

PLATE 91. *A. Acaulon rufescens* (by Seville Flowers). 1, plant × 25; 2, 2, leaves right to left outer to inner × 30; 3, leaf apex × 600; 4, basal marginal leaf cells × 600; 5, capsules × 75 (lower shows exothecial cells, upper spores).

C. Leaves of *Phascum cuspidatum Americanum.* Fig. 2 is an unusual form (by Seville Flowers).

D. Anoectangium arizonicum (by E. B. Bartram). *a, b*, plants × 1; *c, d*, stem leaves × 40; *e*, apex of stem leaf × 250; *f*, cross section of costa × 250.

E. Rhexophyllum subnigrum (from Bartrams no. 811). 1, leaves × 10; 2, cross section of lower median leaf × 150; 3, cross section of upper median leaf × 150; 4, leaf apex × 150; 5, lower marginal leaf cells × 150; 6, lower leaf cells near costa × 150.

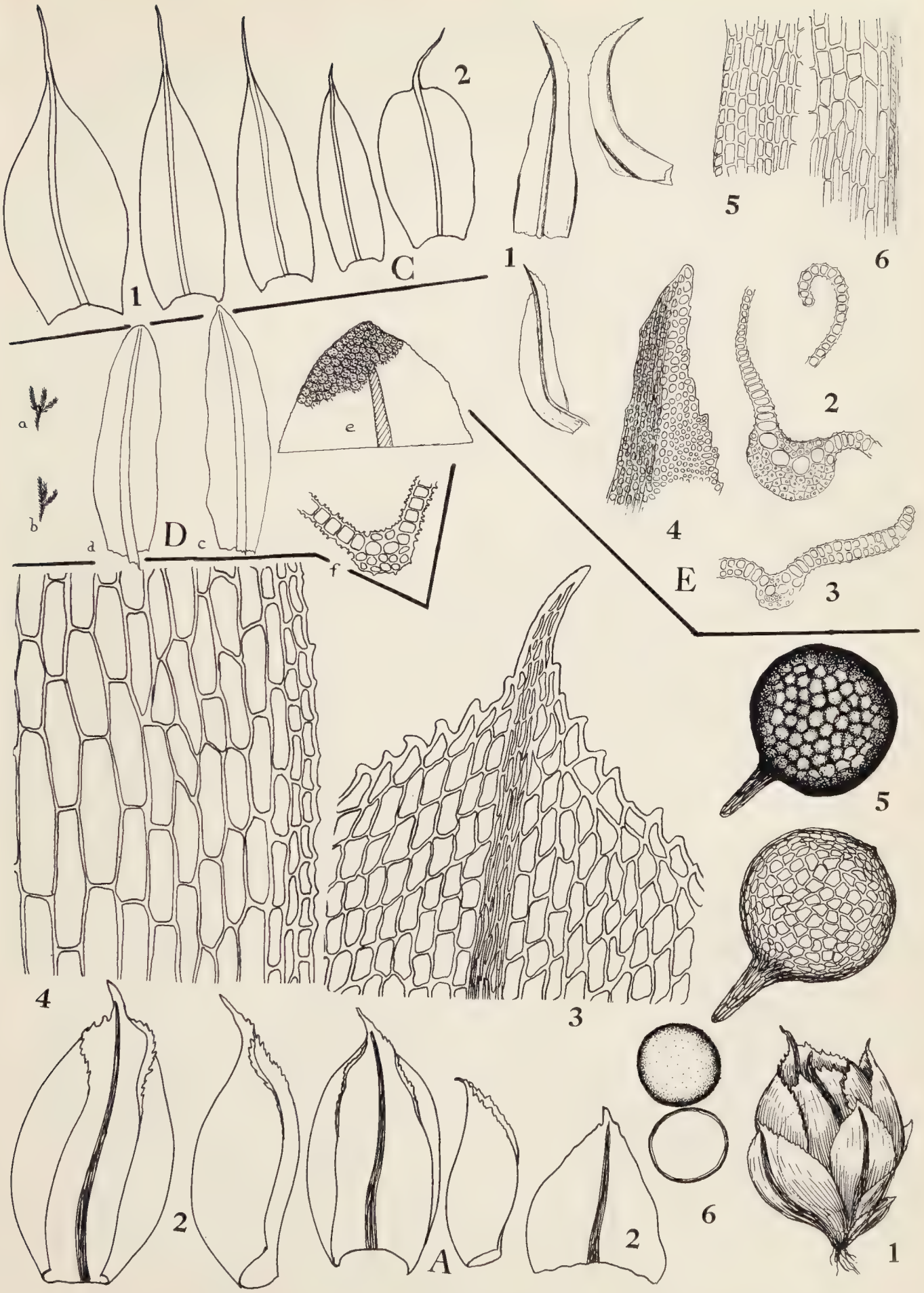

PLATE XCI

PLATE 92. *A.* 1a–1g. *Phascum hyalinotrichum* (from Bot. Gaz. **37:** *pl. 16*). (All figures numbered with a letter.) a, plant × 17; b, lower leaf × 26; b′, upper leaves × 26; c, basal areolation × 135; d, median leaf cells × 135; e, apical leaf cells × 135; f, capsule × 26; g, calyptra × 26.

A. Acaulon rubrum (from Dixon, Handb. Brit. Mosses (Ed. 1) pl. 25).

*, plant much enlarged; 3, leaf; 3a, leaf apex; 3c, upper leaf cells.

8. *Acaulon rufescens* (from Roth, Ausser Europ. Laubm. *pl. 20*). The figures are self explanatory.

B. Acaulon Schimperianum (from Sull. Icones Musc. *pl. 9*) 2, plant much enlarged; 4, 5, leaves; 6, perichaetial leaf; 7, cross section of leaf; 8, cells of leaf apex; 9, basal cells; 10, capsule in perichaetial leaf; 12, sporophyte with calyptra; 13, dehiscing capsule; 14, spore; 15, calyptra.

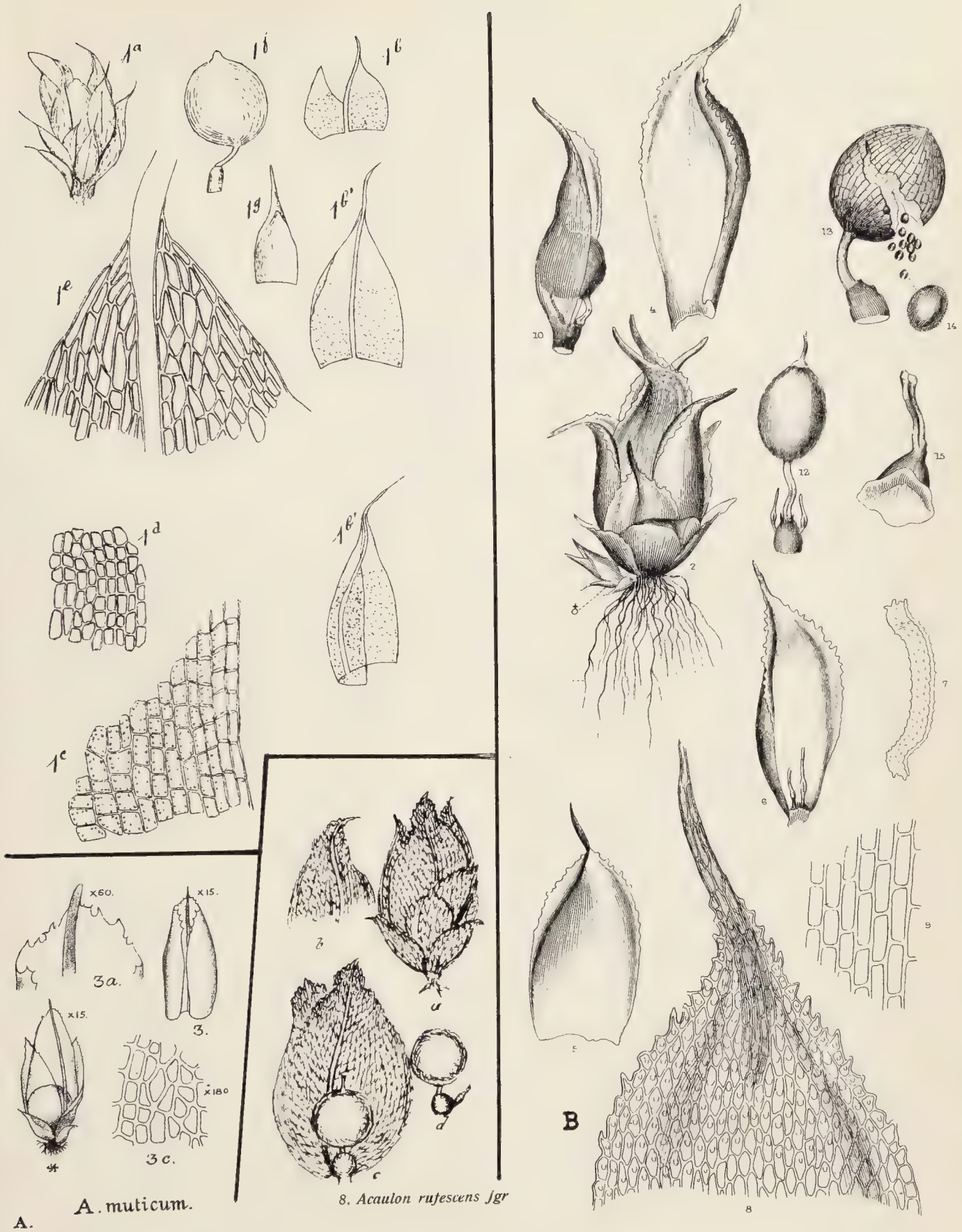
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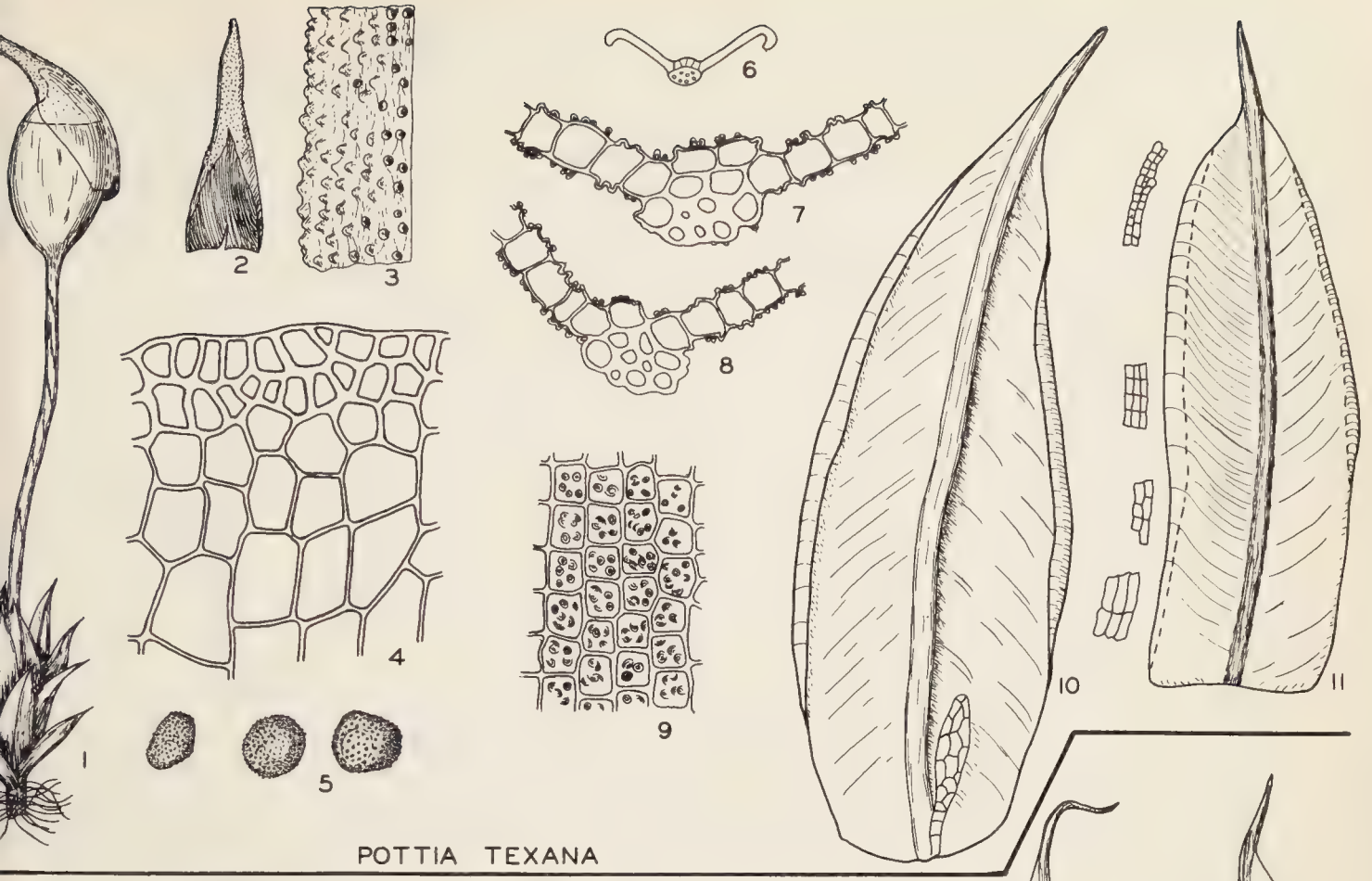
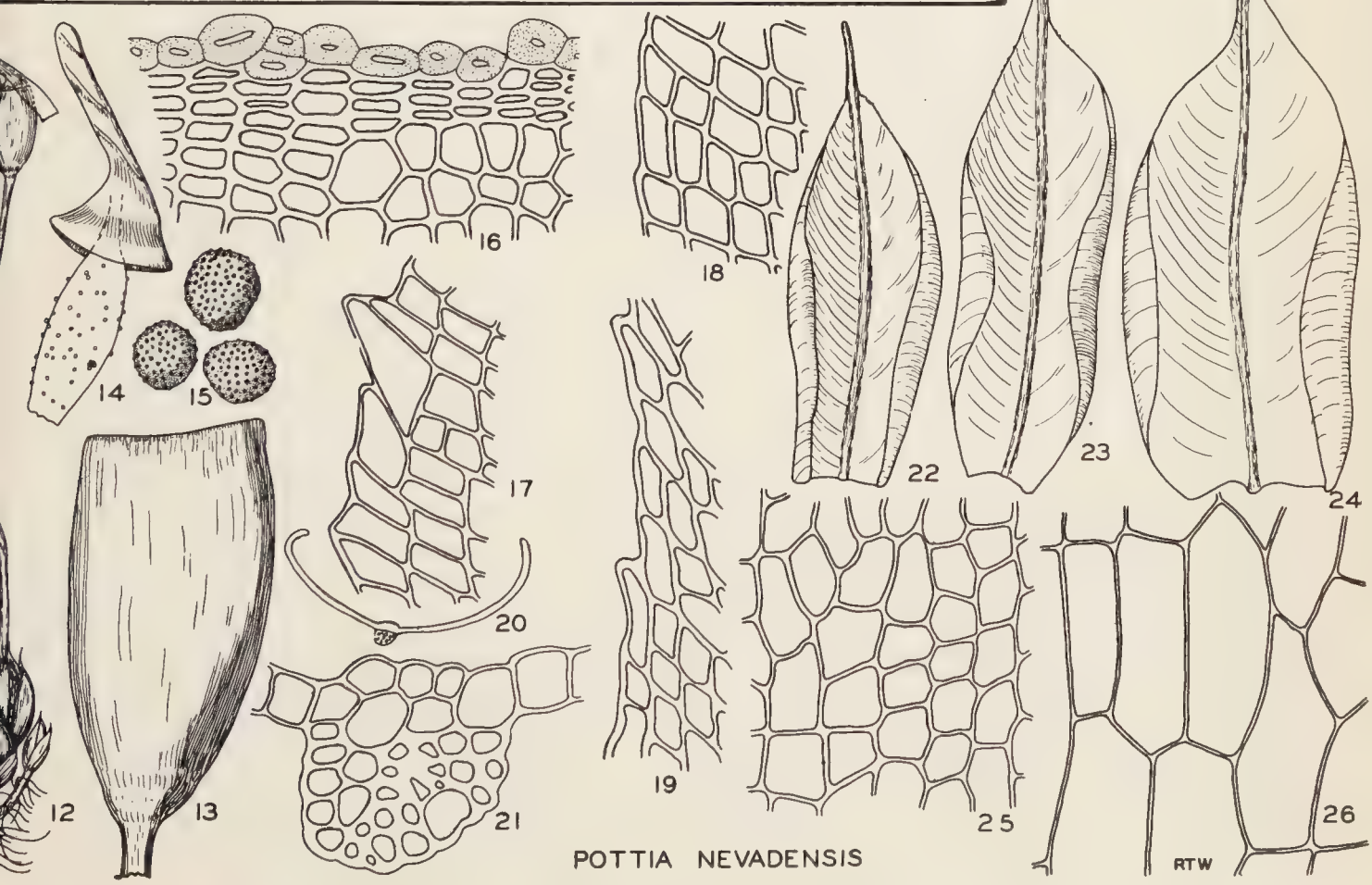
PLATE XCII

PLATE 93. *Pottia texana.* **1,** plant × 20; **2,** calyptra × 28; **3,** portion of upper part of calyptra × 308; **4,** portion of urn mouth × 308; **5,** spores × 308; **6,** outline of cross section of leaf at about the middle × 76; **7, 8,** cross sections of costae from two leaves at about leaf middle × 308; **9,** upper median leaf cells × 308; **10,** dorsal view of upper leaf with attached antheridium × 76; **11,** ventral surface of another leaf × 76.

Pottia nevadensis. **12,** plant × 6.4; **13,** urn × 28; **14,** lid with attached columella × 28; **15,** spores × 308; **16,** portion of urn mouth × 308; **17, 18, 19,** leaf margins near apex × 308; **20,** outline of leaf cross section at about the middle × 28; **21,** cross section of costa at about leaf middle × 308; **22, 23, 24,** ventral surface of upper leaves × 28; **25,** median cells × 308; **26,** basal cells × 308.



POTTIA TEXANA

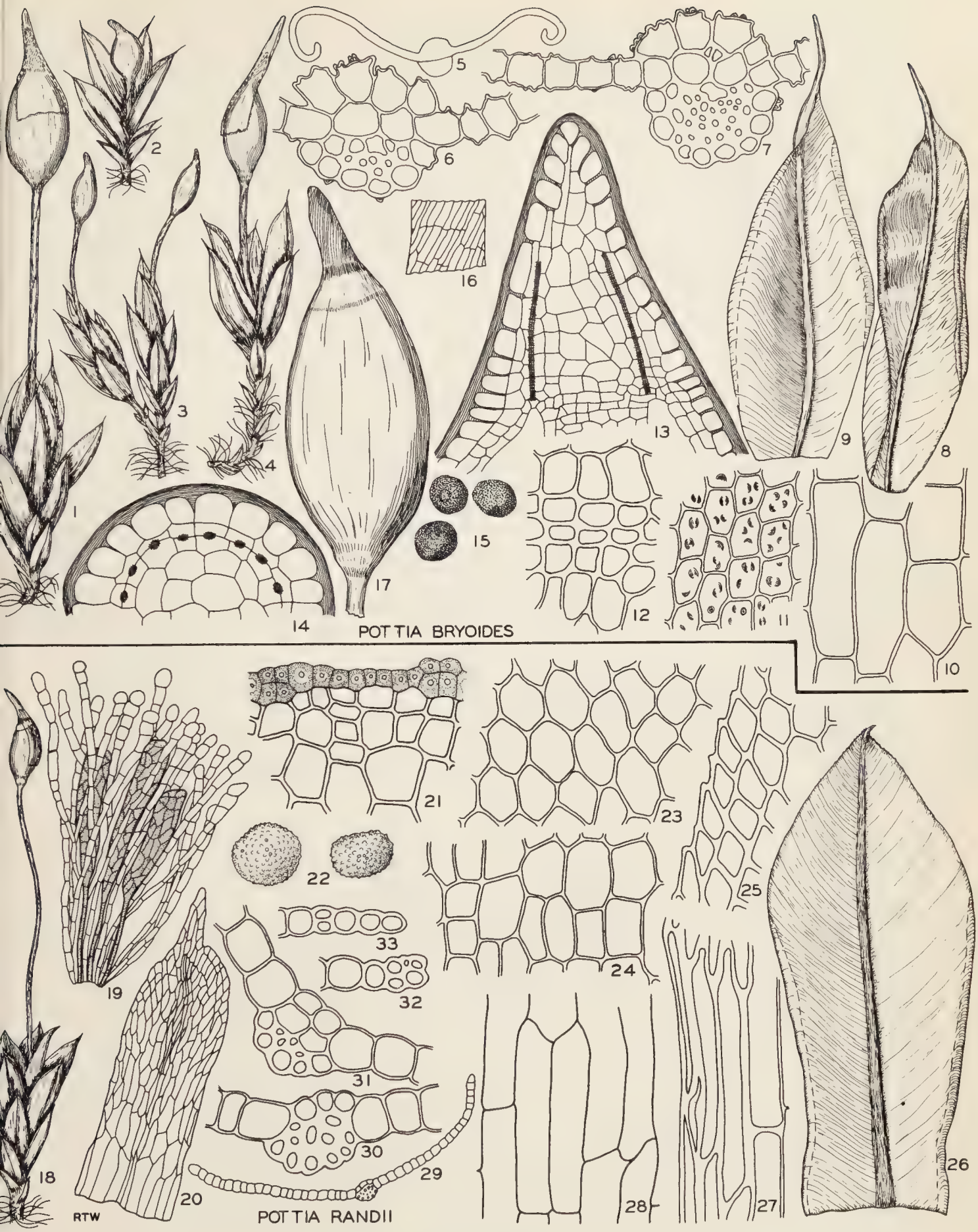


POTTIA NEVADENSIS

PLATE XCIII

PLATE 94. *Pottia bryoides.* **1**, plant × 12; **2**, **3**, **4**, plants × 8; **5**, outline of leaf cross section at leaf middle × 76; **6**, **7**, cross sections of costae from two leaves at about leaf middle × 308; **8**, **9**, leaves × 28; **10**, basal cells × 308; **11**, upper median cells × 308; **12**, cells at junction of lid and urn × 308; **13**, **14**, longitudinal and cross sections respectively of lid. (Redrawn from Limpricht l. c. *figs. 72 and 73;* **13** has a magnification of 180 times); **15**, spores × 308; **16**, section of lid showing spiral arrangement of cells × 76; **17**, capsule × 28.

Pottia Randii. **18**, plant × 8; **19**, three antheridia among paraphyses × 76; **20**, leaf subtending antheridia × 76; **21**, portion of urn mouth × 308; **22**, spores × 308; **23**, leaf cells near apex × 308; **24**, leaf cells at upper median portion × 308; **25**, marginal cells near apex × 308; **26**, leaf × 28; **27**, marginal cells just below middle × 308; **28**, leaf cells a little above the base × 308; **29**, cross section of leaf just above middle × 76; **30**, **31**, cross sections of costae from two leaves just above middle × 308; **32**, cross section of margin just below middle × 308; **33**, cross section of margin just above middle × 308: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POTTIA BRYOIDES
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POTTIA RANDII

PLATE XCIV

PLATE 95. *Pottia arizonica.* **1,** plant × 12; **2,** calyptra × 28; **3,** portion of upper part of calyptra × 308; **4,** exothecial cells × 308; **5,** portion of urn mouth × 308; **6,** urn mouth × 76; **7,** spores × 308; **8, 9, 10,** leaves × 76; **11,** leaf with antheridium × 28; **12,** outline of leaf cross section at about leaf middle × 76; **13,** cross section of costa at about leaf middle × 308; **14,** median cells × 308; **15,** basal cells × 308.

P. arizonica var. *mucronulata.* **16, 17,** leaves × 76; **18, 19,** urn mouths × 76.

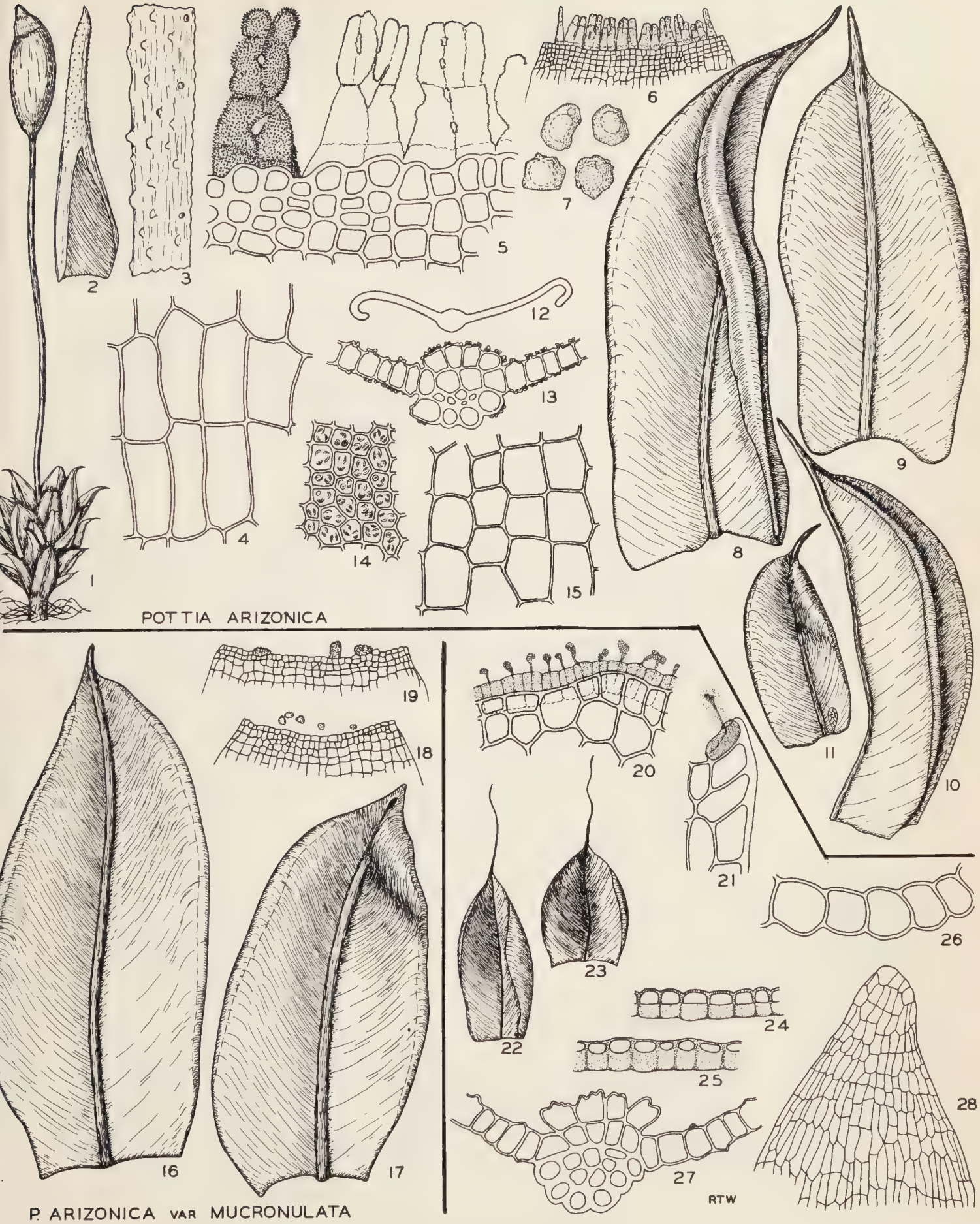
20, 21, *P. truncata.* **20,** portion of urn mouth from outside showing the annular filaments × 308; **21,** longitudinal-radial view of annulus and annular filament × 308.

22, 23, two leaves of *P. latifolia* var. *pilifera* × about 20.

24–26, *P. latifolia.* **24, 25,** cross sections of leaf cells from upper half of leaf × 308; **26,** cross section of leaf cells from lower half of leaf × 308.

27, cross section of costa of *P. lanceolata* at about leaf middle × 308.

28, tip of capsule of *P. Fosbergii* × 76.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POTTIA ARIZONICA
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RTW
P. ARIZONICA VAR MUCRONULATA

PLATE XCV

PLATE 96. *A*. *Pottia Starkeana* (from Bry. Eur. *pl. 125*). 5–8, leaves; 6a, apical leaf cells; 6b, basal cells; 12–15, peristome teeth.

G. The same from Dixon, Handb. Brit. Mosses (Ed. 3) *pl. 23G*.

B. *Pottia latifolia* (from Bry. Eur. *pl. 128*). 1b, plant much enlarged; 2–5, leaves; 4a, apical leaf cells; 4b, basal cells; 9, 11, 13, capsules; 14, 15, 16, peristome; 17, annulus cells. β figures, var. *pilifera*.

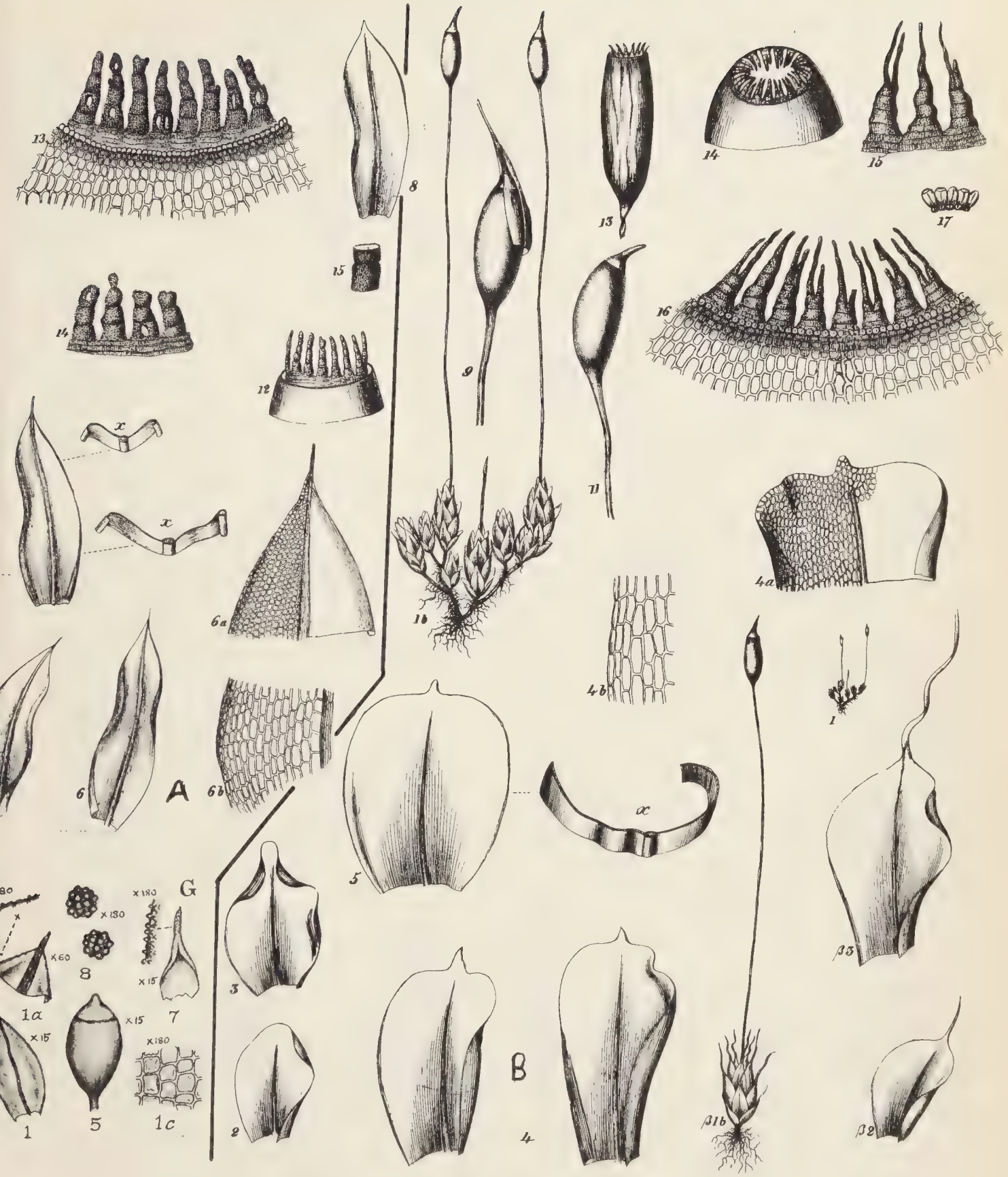

13
8
14
15
13
14
15
17
16
12
9
11
x
x
6a
1b
4a
4b
6
A
6b
5
α
1
β3
3
G
x180
x130
x60
x15
8
7
1a
x15
x15
x180
1
5
1c
2
B
4
β1b
β2

PLATE XCVI

PLATE 97. Left, *Pottia Heimii* (from Bry. Eur. *pl. 124*). 4, leaf enlarged; 4a, leaf apex more enlarged; x, cross section of leaf; 5 and 6, plant with most of the leaves removed, showing the position of antheridia and archegonia; 8, 9, antheridia, paraphyses and archegonium; 11, 12, 13, capsules; 14, mouth of capsule; 15, spores.

Right, *Pottia lanceolata* (from Bry. Eur. *pl. 127*). 4, 5, 6, leaves; 5a, 6a, leaf apices; 5b, basal cells; 7, calyptra; 14, 15, capsules; 17, 18, 19, 20, peristome teeth; 21, 22, annulus cells; 23, spores.

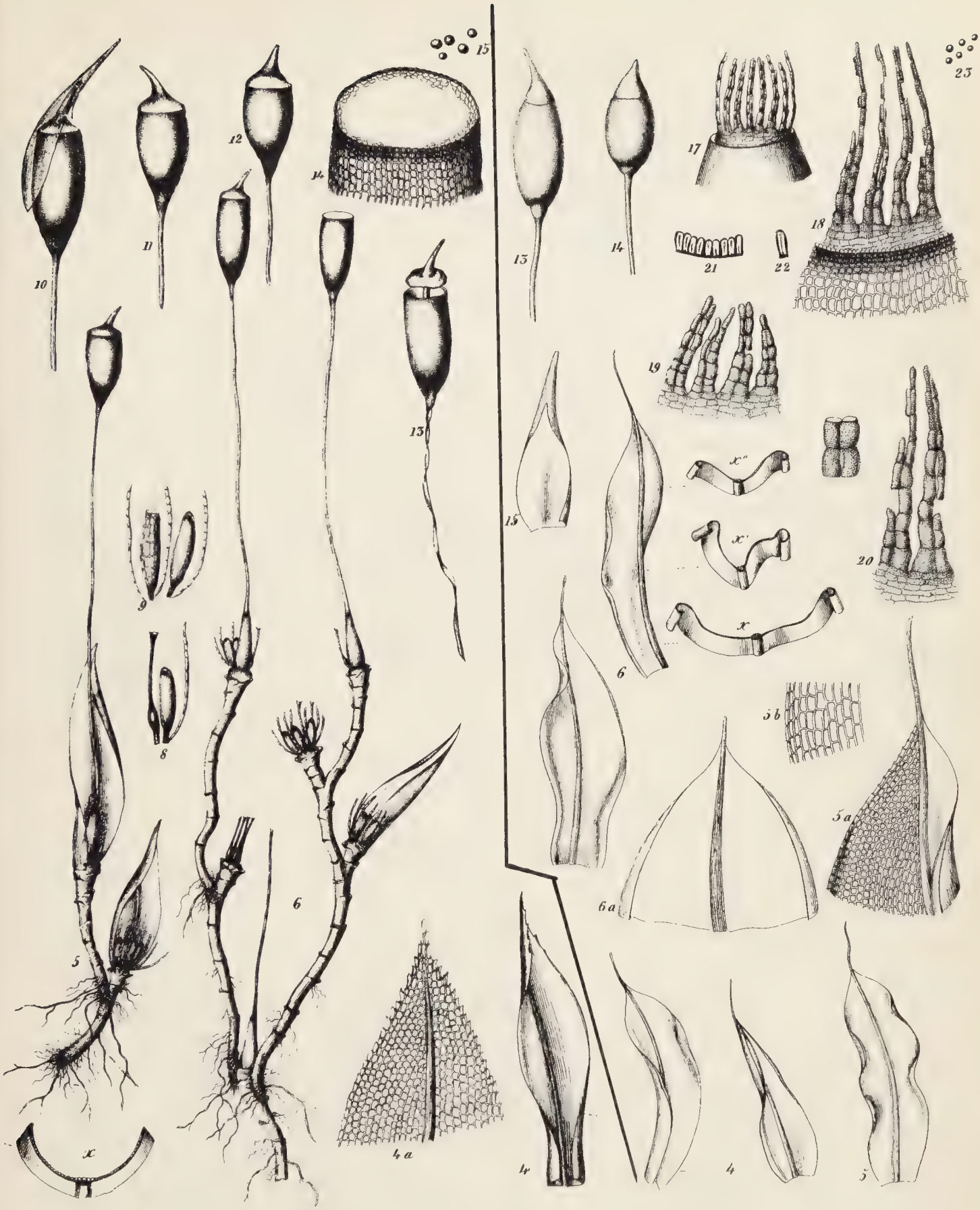

10
11
12
14
15
13
9
8
5
6
4a
x
13
14
17
18
23
21
22
19
15
x''
x'
x
20
6
5b
5a
6a
4
4
5

PLATE XCVII

PLATE 98. *A. Pterygoneurum ovatum* (from Bry. Eur. *pl. 118*). 3, 4, 5, leaves much enlarged; 4x, 5x, cross sections of leaves; 5a, leaf apex; 8, portion of stem with archegonial and antheridial buds; 13, 14, 15, capsules; 16, capsule mouth; 17. calyptra; 18, spores; 19, antheridia and paraphyses.

B. Pterygoneurum lamellatum (from Bry. Eur. Suppl. *pl. 32*). 4, 5, 7, 8, leaves; 5x, cross sections of leaf; 6a, cells of leaf apex; 6b, cells of leaf base; 9, capsule; 10, stem showing position of archegonia and antheridia; 17, operculum showing spiral arrangement of tissues; 24, diagram of cell arrangement in the same; 21, mouth of capsule showing annulus and peristome teeth; 22, portion of capsule mouth more en larged and showing annulus cells.

PLATE XCVIII

PLATE 99. *A. Aloina aloides.* a, plants natural size; 1, leaf much enlarged; 1x, cross section of leaf. Other figures are self explanatory.

B. Pterygoneurum subsessile var. *Henrici* (from drawings by R. T. Wareham). 1, leaf apex much magnified; 2, leaf from archegonial tip.

C. Crossidium griseum (a–e from Limpr. Laubm. **1**: 644, *fig. 181*; g, from drawing by Dr. Flowers). a, plant × 10; b, leaf × 24; c, cross section of leaf × 175; d, operculum × 23; e, peristome × 150; g, peristome from an American plant × 300.

E. Aloina brevirostris. Explanation as for A.

F. Aloina rigida (as *Tortula stellata*). Explanation as for A. (A, E, & F from Braithw. Brit. Moss Fl. **1**: *pl. 30* and *31*.)

E.
a
4.
5.
5
1
a*
1x
Tort. brevirostris
F.
a
b
5
1
4
a*
1x
Tortula stellata.
A
8
a
b
5
1
a*
1x
Tort aloides
B
1
2
a
b
C
d
e
g
c

PLATE XCIX

PLATE 100. *Crossidium squamigerum* (from Bry. Eur. *pl. 140*, as *Barbula membranifolia*). 1, plants × 1; 1b, plants enlarged; 2, 3, leaves; 2a, apical leaf cells; 2b, basal cells; 2x, cross sections of leaf at different points; 4, costal filaments; 5, 6, portions of stem showing position of antheridia and archegonia; 7, antheridial bud; 8, 9, perigonial leaves; 10, antheridium and paraphyses; 11, 12, 13, capsules; 14, 15, 16, peristome and teeth.

1
1.b
12
11
13
14
16
4
2.x''
2.x'
2.x
15
8
10
9
2.b
7
6
5
2
2
2
3
2a
membranifolia

PLATE C

PLATE 101. *A. Crossidium desertorum* (from Bryol. **26:** *pl. 6*). 1, 2, stem leaves × 70; 3, costal filaments × 425; 4, upper leaf cells × 425; 5, section of upper leaf × 70.

B. Crossidium erosum (from Bryol. **27:** *pl. 1*). 1, plant × 1.2; 2, stem leaf × 30; 3, apex of stem leaf × 180; 4, part of upper stem leaf × 30; 5, basal cells of stem leaf × 180; 6, mouth of capsule, annulus and operculum × 30; peristome × 30 (poor); 8, costal filaments × 180.

PLATE CI

PLATE 102. *A. Crossidium aberrans* (from Bryol. **27:** *pl. 2*). 1, 2, 4, stem leaves × 50; 3, upper leaf cells × 300; 5, costal filaments × 300.

B. Crossidium spatulaefolium (Bryol. **27:** *pl. 3*). 1, plant × 1.2; 2, perichaetial leaf × 30; 3, stem leaf × 30; 4, basal cells of perichaetial leaf × 180; 5, operculum × 30; 6, costal filaments × 180; 7, spores × 180.

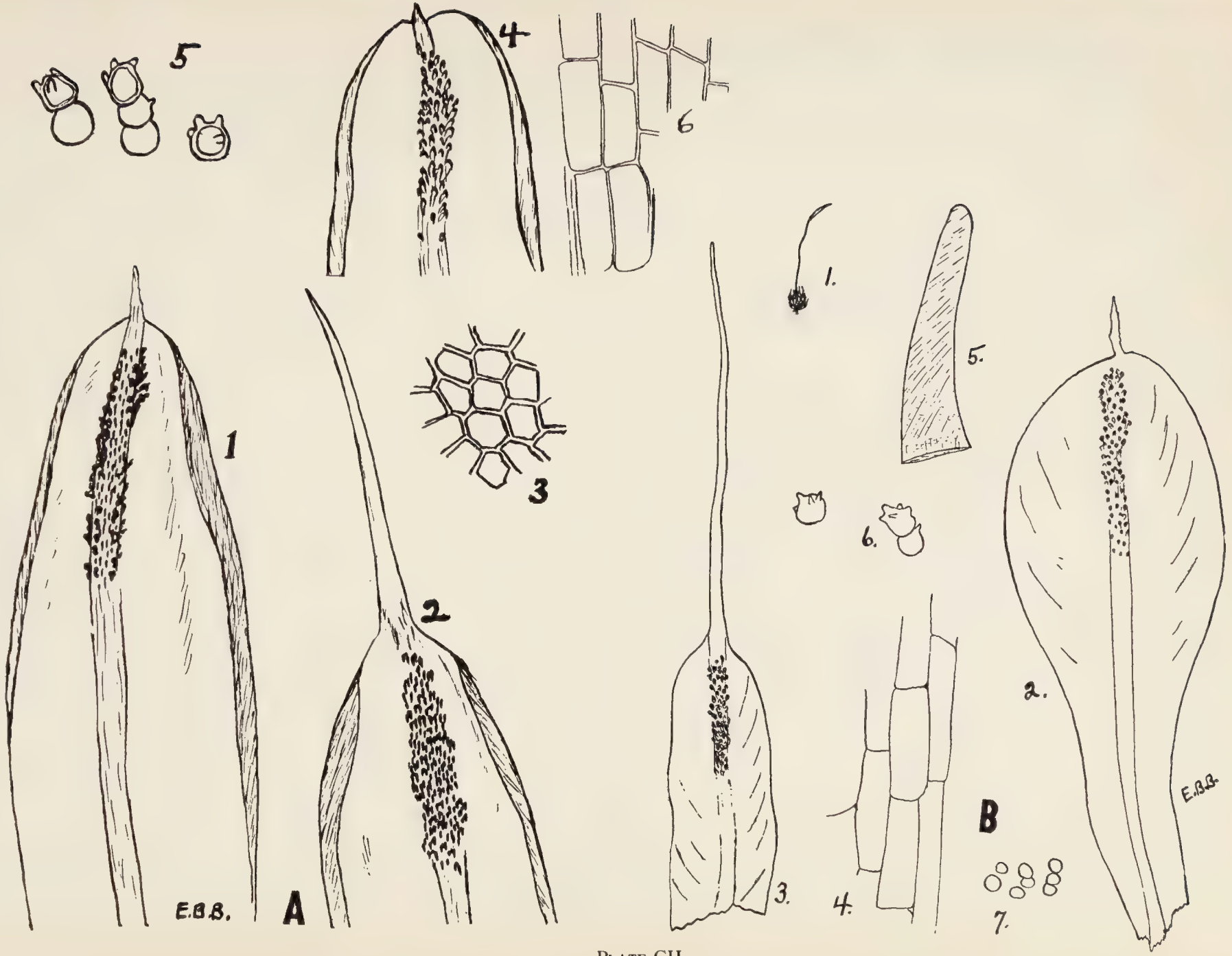


PLATE CII

PLATE 103. *A. Tortula inermis* (from Bry. Eur. *pl. 164*). 2, plant much enlarged; 4, 5, 6, leaves; x, cross sections of leaf; 5a, leaf apex; 7, capsule; 8, operculum showing spiral arrangement of cells; 9, peristome.

B. Cross sections of leaves of *Desmatodon* species (from Bull. Torr. Club. **46:** *pl. 11*, all × 270). 1, *D. latifolius;* 3, *D. Guepini;* 4, *D. plinthobius;* 5, *D. obtusifolius;* 6, *D. Porteri;* 7, *D. systilius;* 8, 9, *D. Sprengelii* (8, published as *D. Garberi*).

X. Pottia Fosbergii (from Bryol. **33:** *pl. 2*). A, plants × 2; B, plant × 18; C, leaves × 88; D, lower leaf cells × 500; E, upper leaf cells × 500; F, spore × 500.

PLATE CIII

PLATE 104. *Desmatodon latifolius* (from Bry. Eur. *pl. 129*). 1, 3, plants × 1; 1b, plant enlarged; 4–7, leaves; 7a, 8, apical leaf cells; 7b, basal cells; 7x, cross sections of leaf; 9, apex of perigonial leaf; 15–19, capsules; 20, 21, 22, peristome teeth; 23, annulus cells.

Lower left, 6–9, leaves of var. *muticus* (from Bry. Eur. *pl. 130*).

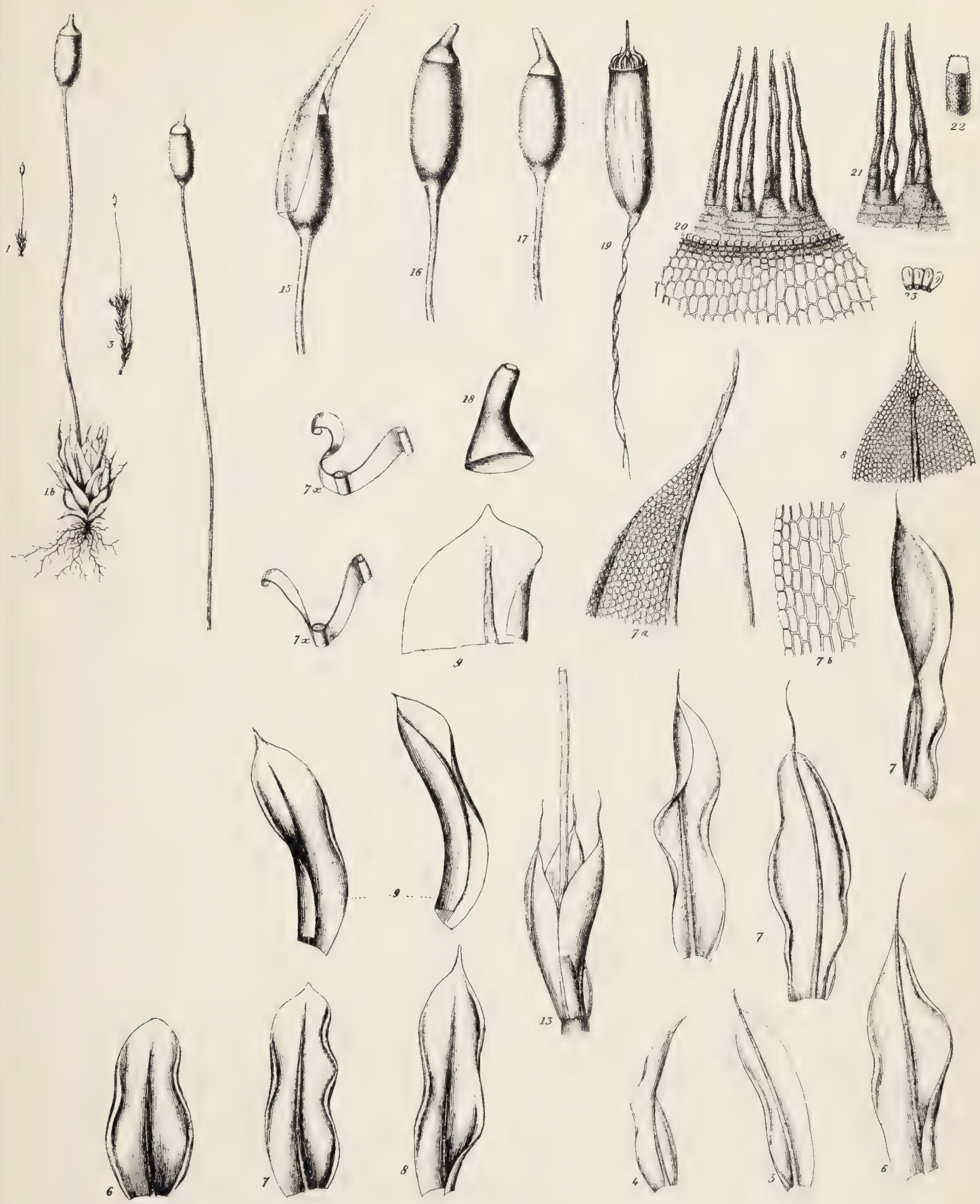


PLATE CIV

PLATE 105. *B. Desmatodon convolutus.* (*Tortula atrovirens*) (From Braithw. Brit. Moss. Fl. **1:** *pl. 31B*). *a*, plant × 1; 1, leaf much enlarged; 1*aa*, apex of leaf more enlarged; 1x, cross section of leaf, structure of costa not shown; 4, paraphysis, antheridium, perigonial leaf; 5, capsule; 8, peristome.

C. Desmatodon Hendersoni (From Bot. Gaz. **15:** *pl. 5C*). a, entire plant; b, lower leaf; c, c, lower leaves; d, d, d, points of the same; e, basal marginal cells; f, upper leaf cells; g, perichaetial leaf; h, capsule; i, exothecial cells; i*, i*, exothecial cells of *Didymodon trifarius.*

E. Desmatodon suberectus (From Braithw. l. c. *pl. 41E*, except *f. 2* from Bull. Torr. Club. **46:** *pl. 11*). a, plant × 1; 1, leaf much enlarged; 1a, leaf apex; 1ab, leaf base; 1x, cross section of leaf, cross section of costa inaccurate; 2, cross section of leaf × 270; 5, capsule; 8, peristome.

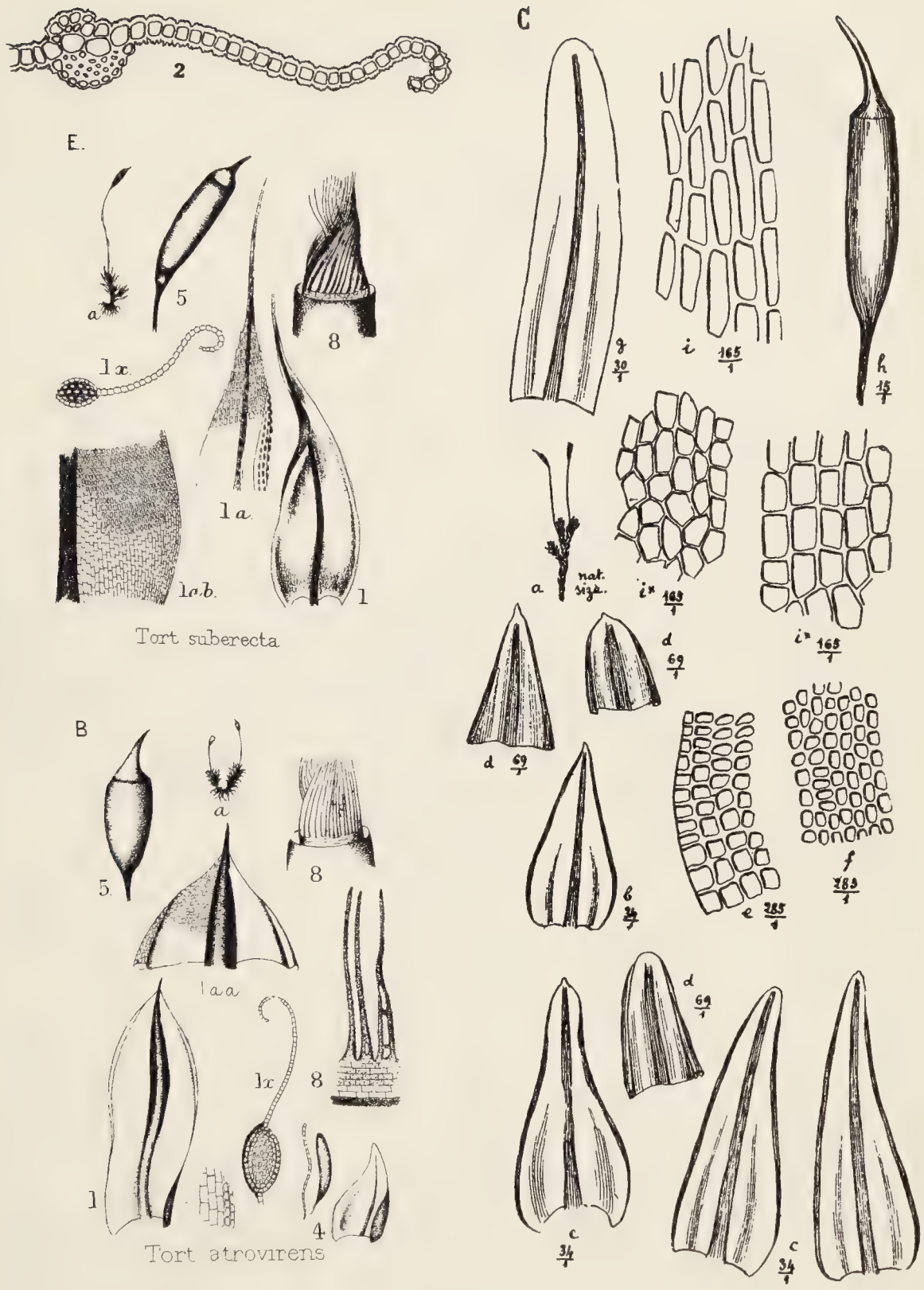

2
E.
a
5
8
1x
1a
1a.b.
1
Tort suberecta
B
5
a
8
1aa
1x
8
1
4
Tort atrovirens
C
g
30/1
i
165/1
h
15/1
a
nat. size.
i*
183/1
i*
165/1
d
69/1
d
69/1
b
34/1
e
285/1
f
283/1
d
69/1
c
34/1
c
34/1

PLATE CV

PLATE 106. Left, *Desmatodon Guepinii* (from Bry. Eur. *pl. 133*). 3, 4, leaves; 4a, cells at leaf apex; 4b, cells at leaf base; 4x, cross section of leaf; 6, antheridial bud; 7, perigonial leaves; 9, antheridia; 10, 11, 12, capsules showing calyptra, operculum and peristome respectively; 13, 14, peristome; 15, annulus cells; 16, spores.

Right, *Desmatodon systilius* (from Bry. Eur. *pl. 131*). 3–6, leaves; 9–12, upper and perichaetial leaves; 5a, apex of leaf; 7, antheridial bud; 8, archegonium antheridia and paraphyses; 14, capsule; 15, portion of peristome and annulus.

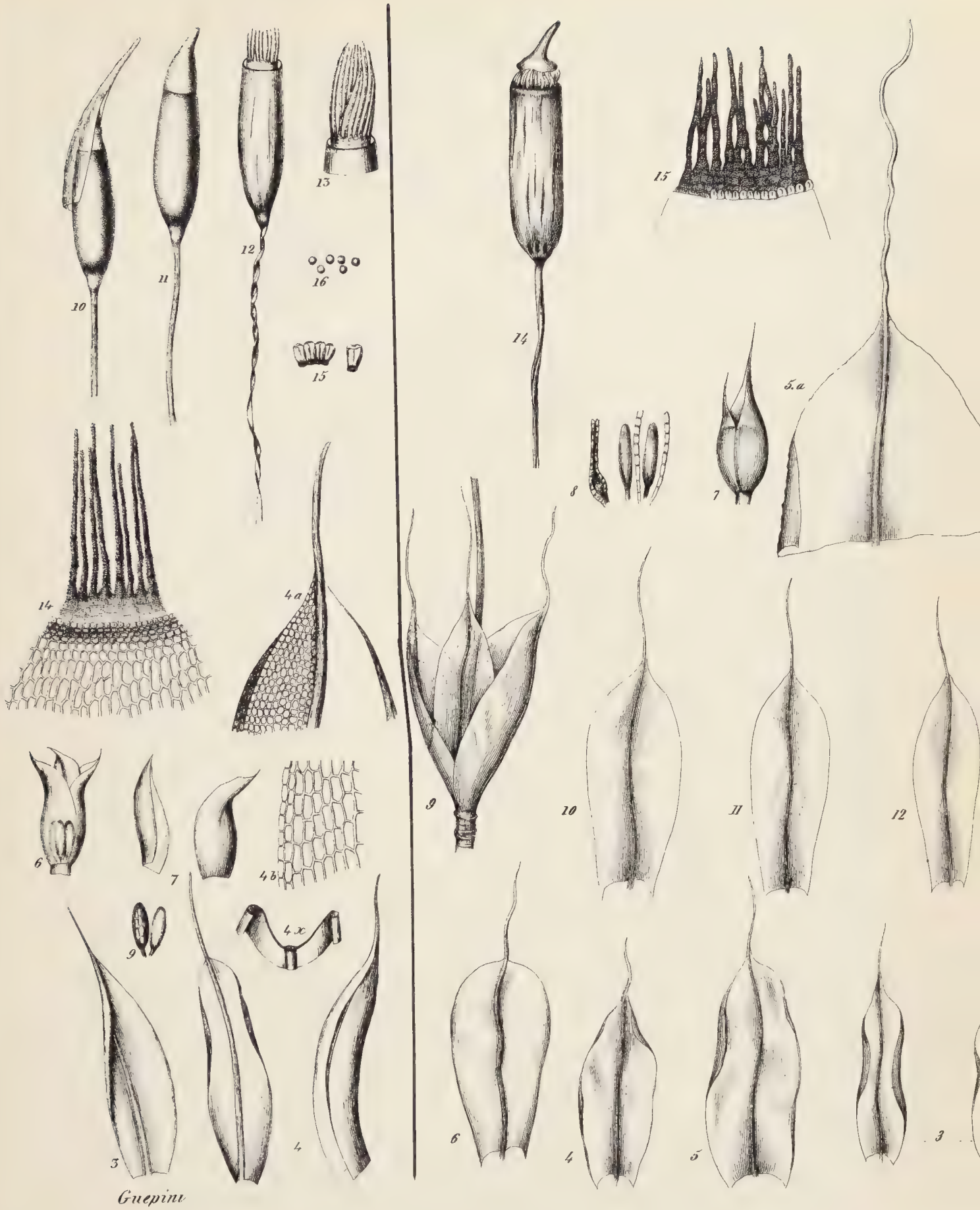

10
11
12
13
16
15
14
15
5.a
8
7
14
4.a
9
6
7
4.b
10
11
12
9
4.x
3
4
6
4
5
3
Guepinu

PLATE CVI

PLATE 107. Left, *Desmatodon Laureri* (from Bry. Eur. *pl. 135*). 4, 5, leaves; 5a, apex of leaf with excurrent costa; 4a, apical leaf cells; 4b, basal cells; 10, capsule showing arcuate seta, calyptra and operculum; 12, 13, peristome; 14, portion of annulus.

Right, *Desmatodon cernuus* (from Bry. Eur. *pl. 134*). 4, 5, 11, leaves; 4x, cross sections of leaf; 4a, apical leaf cells; 4b, basal cells; 11a, leaf apex; 12, 13, 14, capsules; 15–18, peristome; 19, annulus cells.

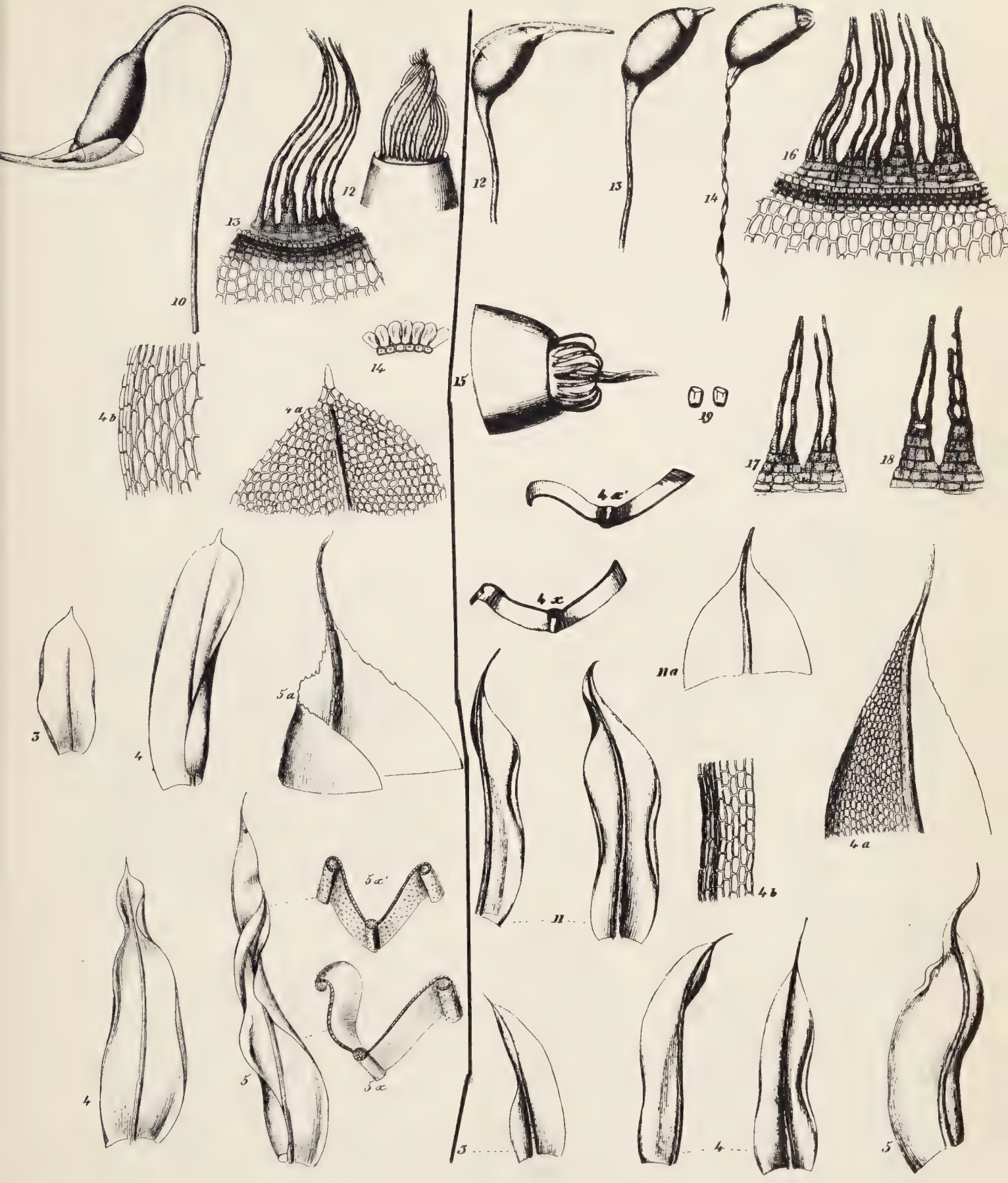


PLATE CVII

PLATE 108. *A. Desmatodon coloradensis.* 1, plant × 5; 2, upper leaves × 30; 3, middle leaves × 30; 4, lower leaves × 30; 5, leaf apex × 300; 6, lower leaf cells × 600; 7, median marginal leaf cells × 600; 8, capsules × 20; 9, mouth of capsule showing portion of annulus and peristome × 75.

B. Desmatodon Sprengelii. 1, moist fruiting plant × 5; 2, dry sterile plant × 5; 3, leaves × 30; 4, perichaetial leaf × 30; 5, serrate leaf apices × 75; 6, cross sections of leaf × 300; 7, basal leaf cells × 300; 8, median cells × 300; 9, portion of peristome × 300; 10, capsule × 20. (Drawings by Seville Flowers.)

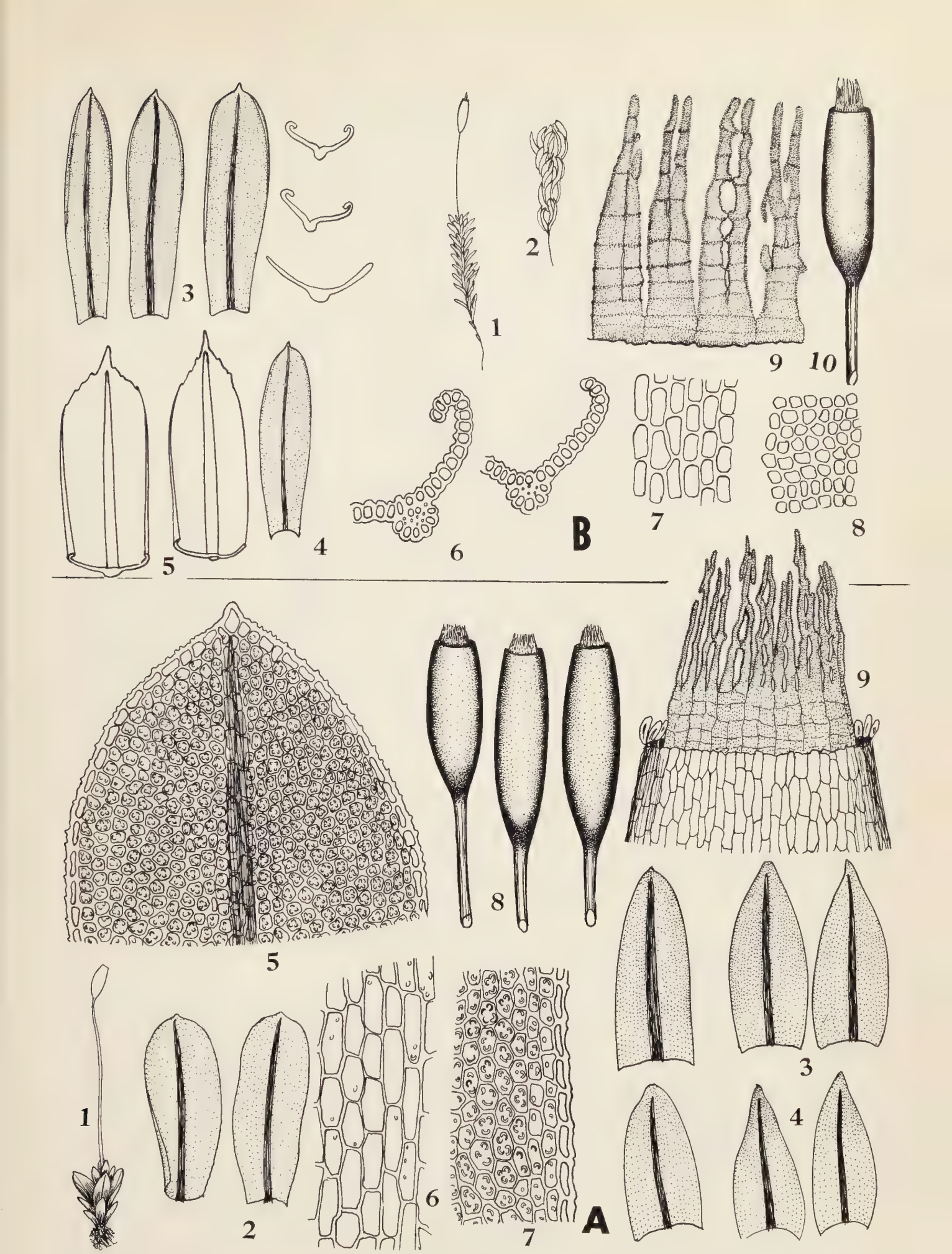


PLATE CVIII

PLATE 109. *A. Trichostomopsis brevifolia* Bartram. a–b, dry plants × 1½; c, moist plant × 4; d–e, stem leaves × 24; f, inner perichaetial leaf × 24; g, apex of stem leaf × 60; h, upper leaf cells × 360; i, basal cells × 360; k, two cross-sections from upper leaf margin × 360; l, cross-section of costa about mid-leaf × 360; m, capsule × 9; n, part of peristome × 120; o, part of peristome fork × 700; p, lid × 24.

B. Bryobrittonia pellucida. 1, plant × 1; 2, upper stem leaf × 8; 3, lower stem leaf × 8; 4, cross section of leaf × 160; 5, cross section of stem × 160, a, section of costa at point where it joins stem, b, base of radicle, c, costa where it is adnate to the stem; 6, apex of leaf × 285; 7, leaf cells at margin a little above the base × 285; 8, cross section of upper costa × 160.

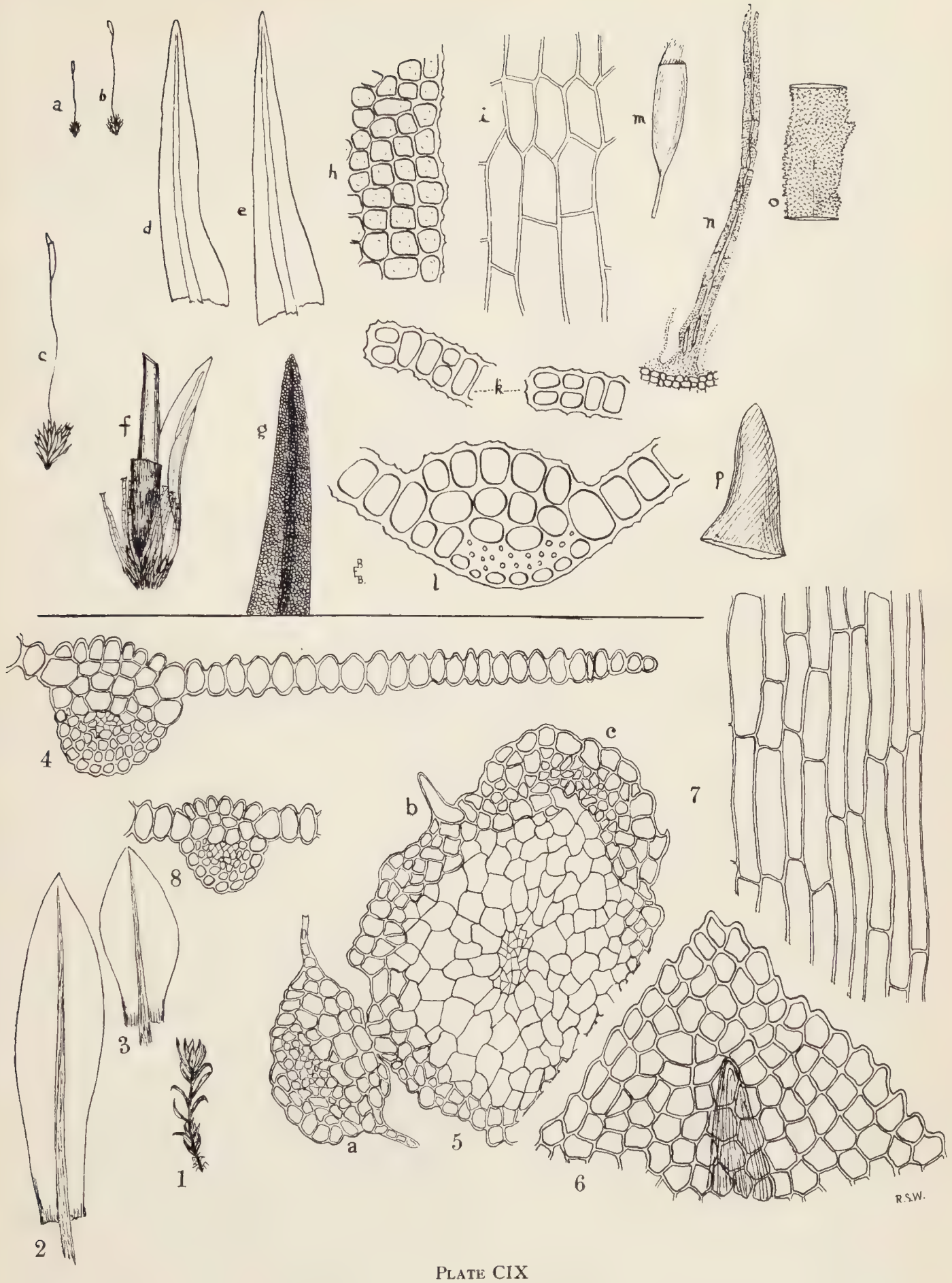


PLATE CIX

PLATE 110. *A. Trichostomopsis diaphanobasis.* 1, plants × 3; 2, capsules × 13; 3, peristome and annulus × 50; 4, leaves from type collection × 20; 5, from Orcutt's no. 7053 × 20; 6, cross sections of leaf × 400; 7, cross section of leaf near base × 400; 8, leaf apices × 400; 9, median marginal leaf cells × 400; 10, basal cells × 400.

B. Trichostomopsis Fayae. 1, plants × 3; 2, leaves × 20; 3, leaf sections × 400; 4, basal leaf cells × 400; 5, median marginal leaf cells × 400; 6, leaf apex × 400; 7, capsules × 13; 8, peristome × 50.

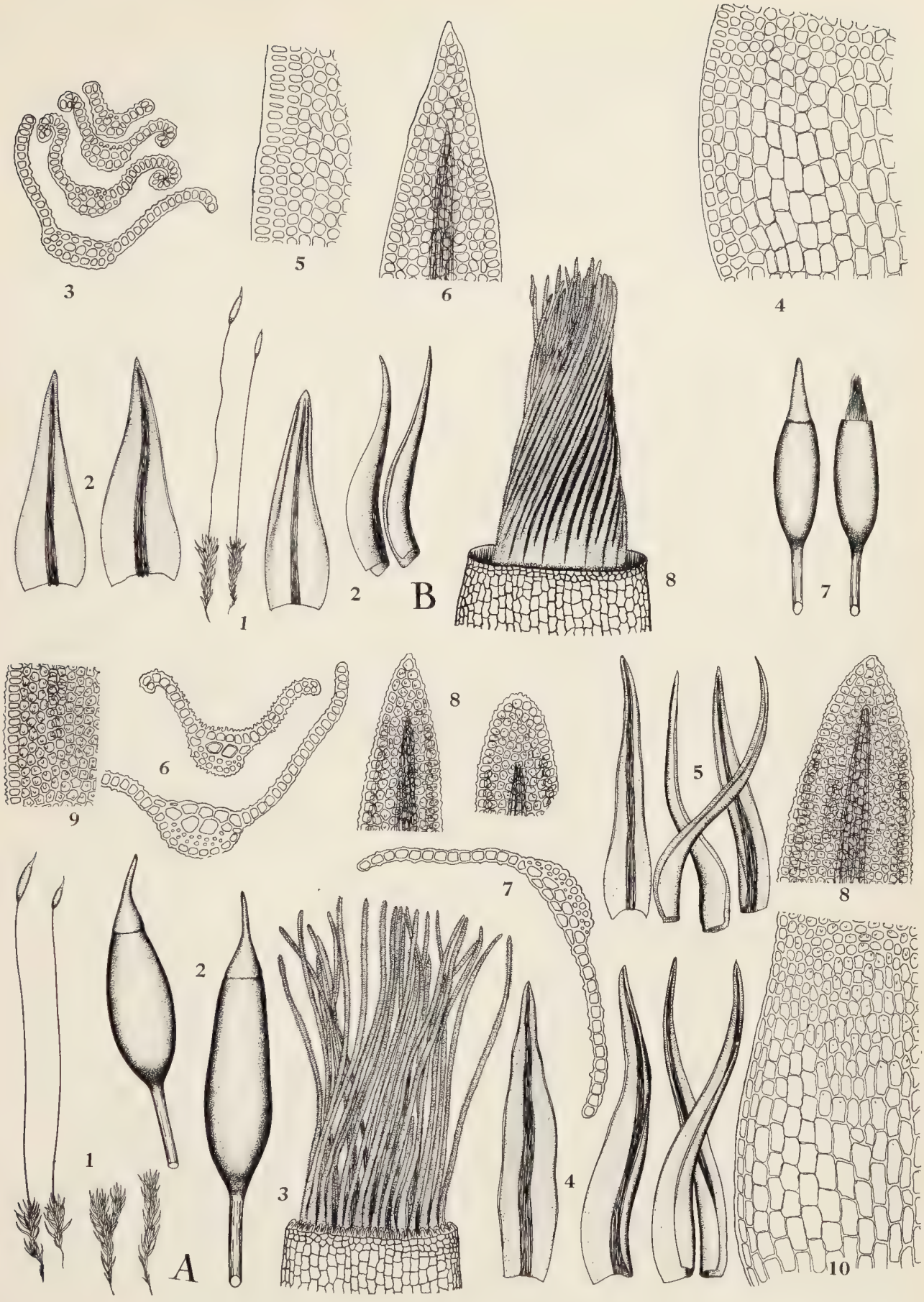


PLATE CX

PLATE 111. *A. Tortula aurea* (From Bull. Torr. Club, **51**: *pl. 6*). 1, 2, dry plants × 4/5; 3, upper part of moist plant × 12; 4, 5, stem leaves × 16; 6, leaf apex × 40; 7, leaf apex × 80; 8, portion of leaf cross section × 240; 9, upper leaf cells × 240; 10, basal marginal cells × 240; 11, basal cells next costa × 240.

B. Tortula fragilifolia (From Bull. Torr. Club, **51**: *pl. 7*). 1, moist plant × 4/5; 2, moist plant × 4; 3, 4, 5, 6, leaves × 16; 7, propagula × 80; 8, basal cells to left of costa × 80; 9, portion of cross section of leaf from lower half × 240; 10, cross section of costa from upper half of leaf; 11, upper leaf cells × 480.

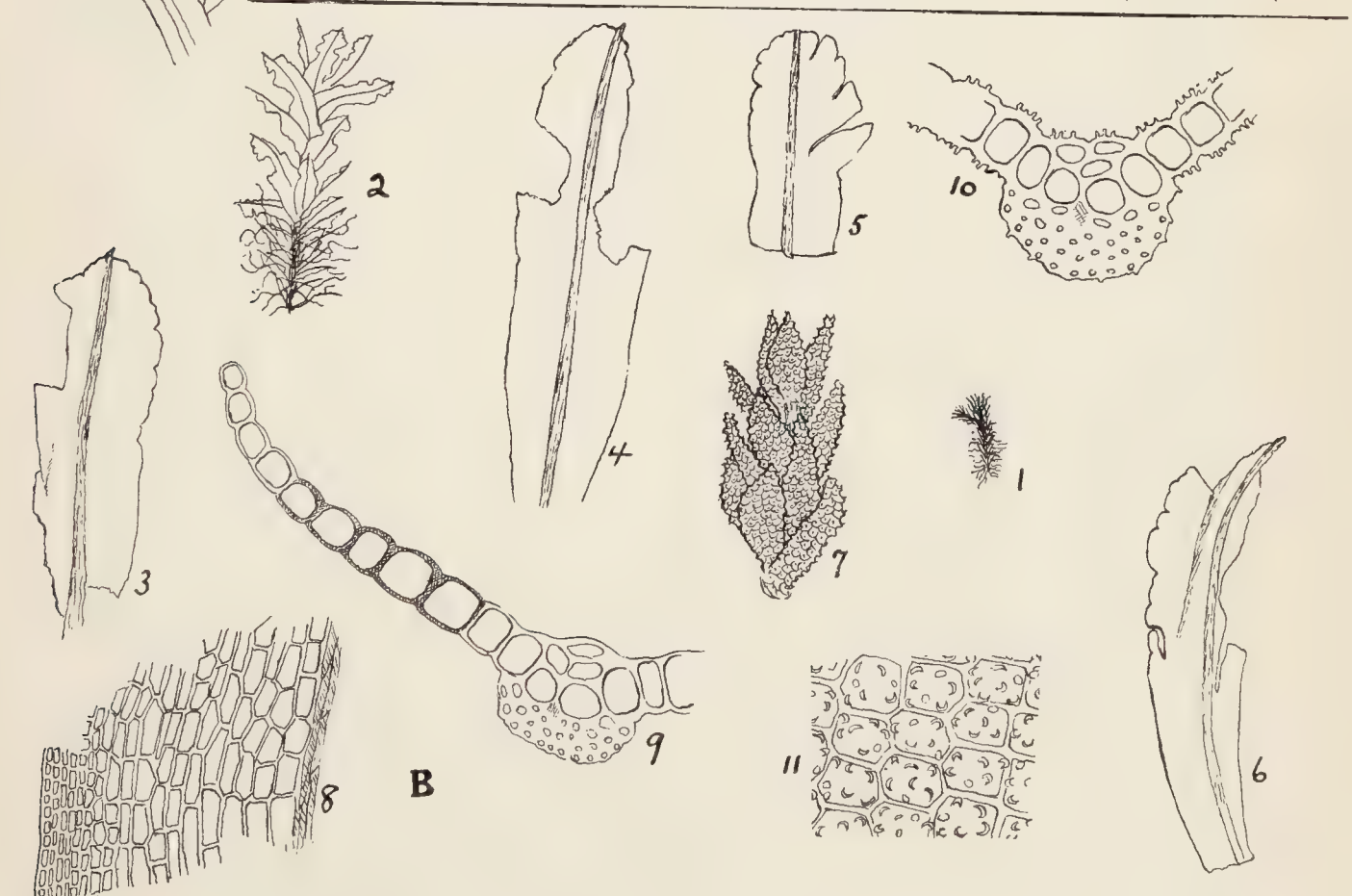


PLATE CXI

PLATE 112. *A. Tortula brevipes. B. Tortula amplexa. C. Tortula Bolanderi.* This plate was very kindly prepared by Miss Olivia Embrey from original pencil sketches by W. S .Sullivant, now at the Farlow Herbarium of Harvard University. The figures are self-explanatory.

PLATE CXII

PLATE 113. *A. Tortula Williamii* (From Bryol. **27**: *pl. 11*). 1, 2, plants about × 1; 3, moist plant × 5; 4, cross section of costa from lower half of leaf; 5, 6, stem leaves × 20; 7, cross section of leaf × 50; 8, cross section of part of upper leaf × 300; 9, leaf apex × 300; 10, one side of leaf base × 100.

*B. Tortula caroliniana** (From Bryol. **23**: *pl. 5*). 1, dry plant × 1.6; 2, dry plant × 3; 3, moist plant × 10; 4, leaf × 32; 5, section of costa × 288; 6, leaf apex × 160; 7, right side of leaf base × 160; 8, upper leaf cells × 400; 9, apex of leaf with propagula × 40; 10, propagula × 96.

* In the illustration the papillae are represented as too irregular in shape and somewhat too large. Their shape is that of a perfectly regular crescent, except as they sometimes form a complete, but again perfectly regular ring. This last tendency is stronger on the dorsal surface and also increases with exposure of the plants to light and sun.

In the illustration they are slightly flattened down by the cover-glass; when undisturbed the propagula rise exactly perpendicular to the leaf-surface and are not at all confined to the immediate apex of the leaf. The costa is represented as too broad in the figure.

PLATE CXIII

PLATE 114. *Tortula pagorum* (photograph by A. T. Beals). 1, plant × 80; 2, cells at upper edge of leaf × 450; 3, base of leaf × 120; 4, propagula × 60.

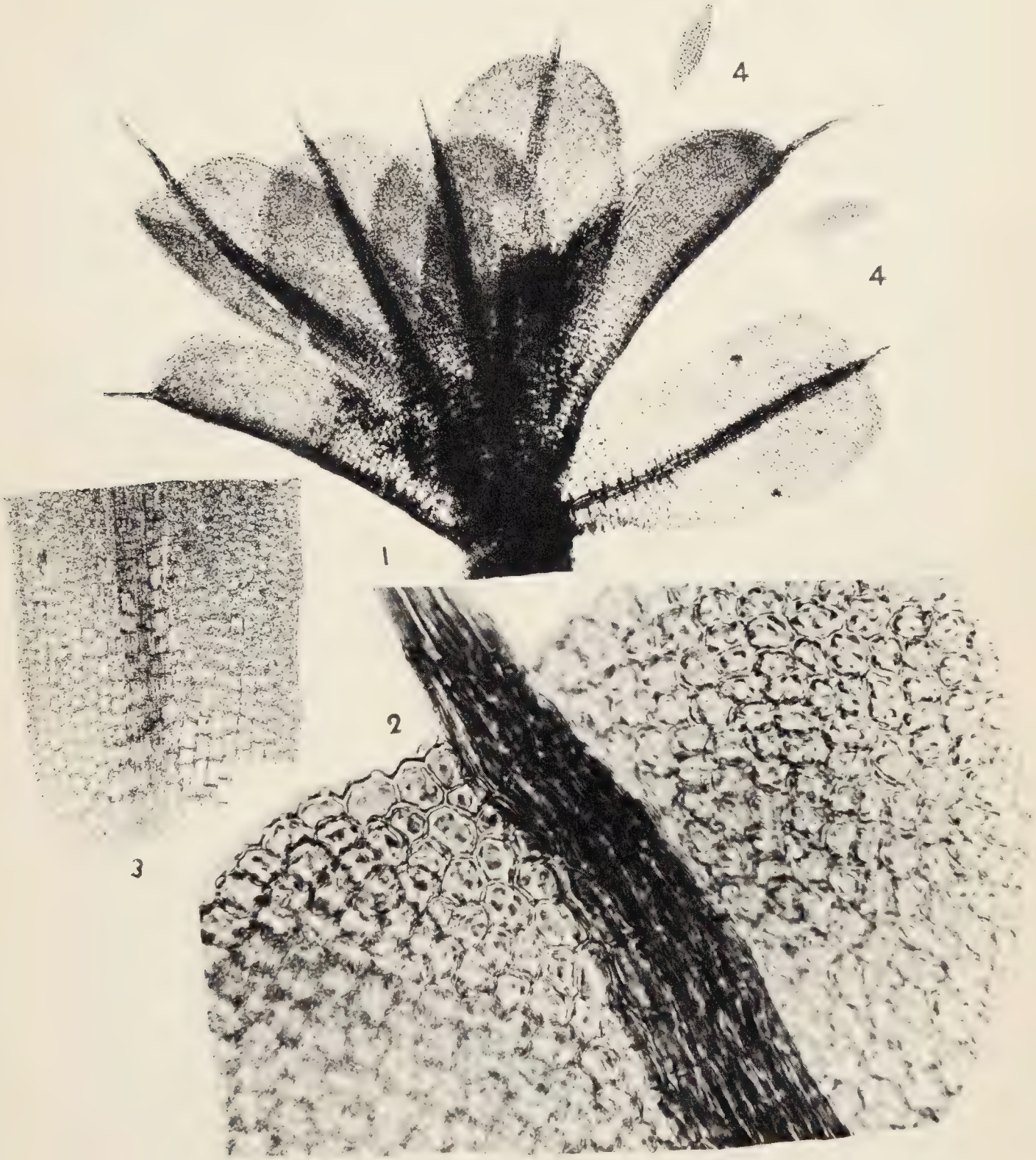


PLATE CXIV

PLATE 115. *A. Tortula obtusissima.* 1, Fertile plant × 7; 2, individual leaves × 17; 3–5, sections from progressively higher levels of a leaf × 67; 6, detail of areolation of upper part of leaf × 533.

B. Tortula Bartramii. 1, whole sterile plant × 20; 2–5, individual leaves × 23; 6, sections of upper part of leaf × 67; 7, section of leaf to show papillae × 667; 8, detailed areolation of upper part of leaf × 533.

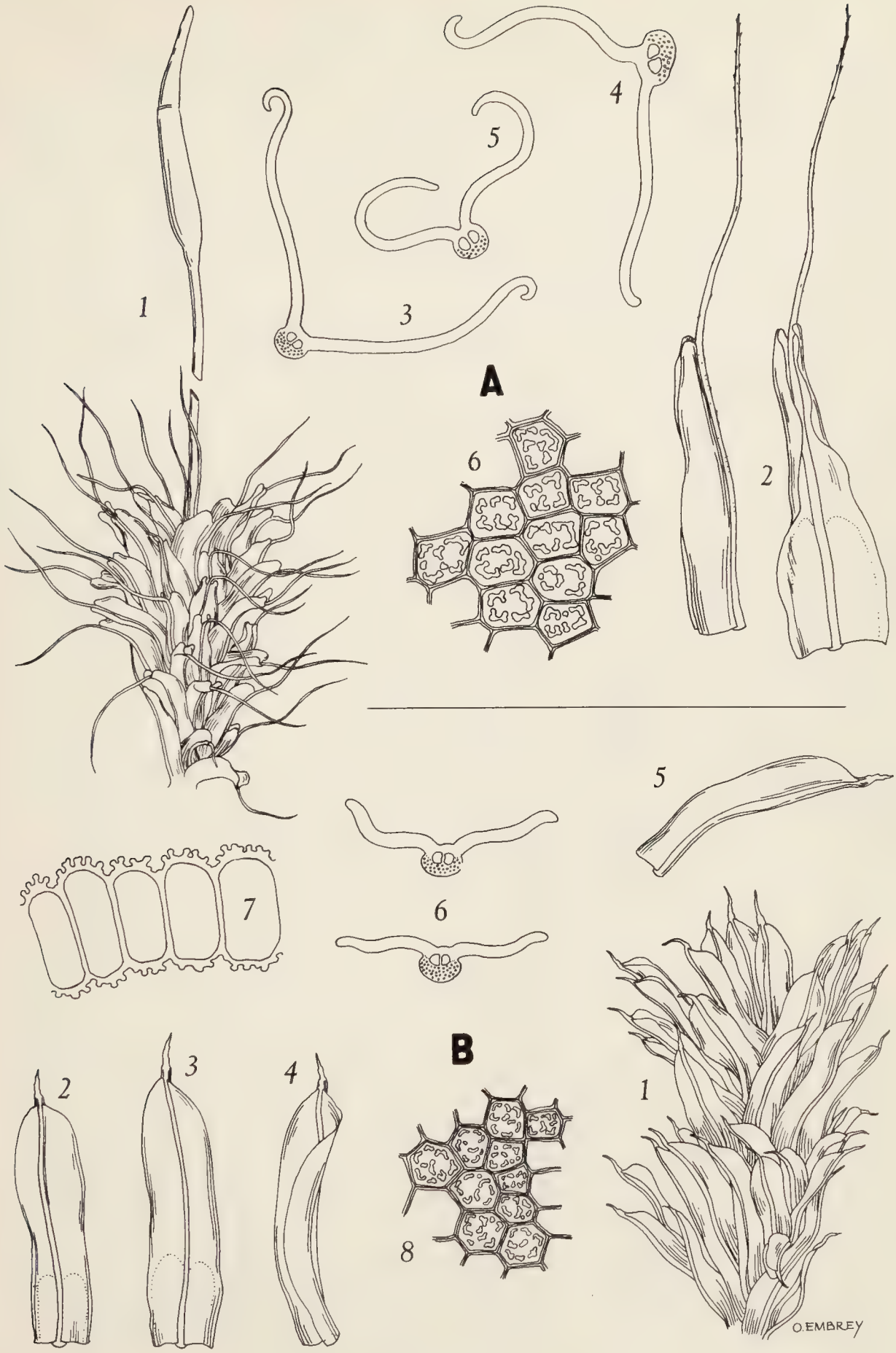


PLATE CXV

PLATE 116. *A. Tortula propagulosa* (from Bryologist **36:** *pl. 1*). 1, plant × 25; 2, dorsal view of leaf × 25; 3, apical leaf cells × 200; 4, dorsal view of a portion of leaf base with propagula × 200; 5, cross section of costa × 200.

B. Tortula ruraliformis. 1, leaf; 1a, leaf apex; 1c, upper leaf cells.

C. Tortula princeps (from Braithw. Brit. Moss Fl. **1:** *pl. 33C*). a, plant × 1; 1, leaf; 1x, cross section of leaf; 3, antheridia at base of seta; 7, peristome.

D. Tortula subulata. 1, plant; 1, leaf; 1a, leaf apex; 1c, leaf cells; 1x, cross section of leaf margin; 6, peristome.

D'. Tortula norvegica. 1, leaf; 1a, leaf apex; 1c, upper median leaf cells.

E. Tortula subulata var. *angustifolia.* *, plant; 1, leaf; 1a, leaf apex; 1c, marginal leaf cells; 1x, cross section of leaf margin.

(*B, D, D', E,* from Dixon, Handb. Brit. Mosses Ed. 3; *B* & *D'* from *pl. 26; D* & *E* from *pl. 25.*)

Fig. 11, cross section of leaf of *Desmatodon cernuus* × 270; fig. 12, cross section of leaf of *D. Laurer* × 270. Both from Bull. Torr. Club. **46:** *pl. 11.*

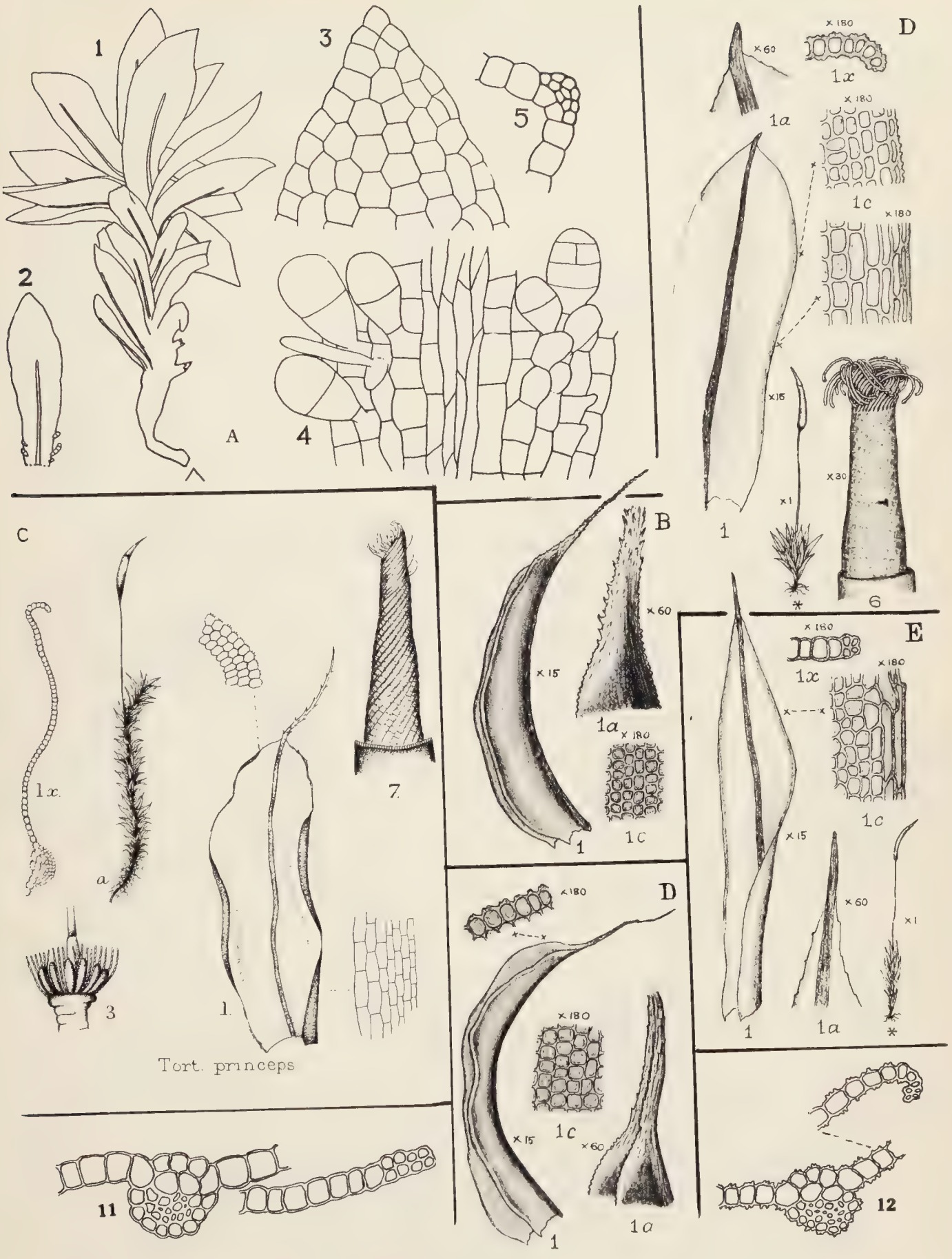


PLATE CXVI

PLATE 117. Left, *Tortula latifolia* (from Bry. Eur. *pl. 164*). 1, 2, 3, plants × 1; 1b, plant magnified; 4–7, leaves; 5x, cross section of leaf; 8, portion of stem with archegonia and base of seta; 9, capsule with calyptra; 10, annulus.

Right. *Tortula laevipila* (from Bry. Eur. *pl. 164*). 1, 2, 3, plants × 1; 2b, plant enlarged; 3, 4, leaves; 4a, cells of leaf apex; 4x, cross sections of leaves; 5, portion of stem with male and female organs; 6, antheridial bud; 7, antheridia and paraphyses; 8, capsule with calyptra; 9, peristome; 10, cells of annulus.

PLATE CXVII

PLATE 118. *Tortula intermedia* (from DeNot. Musci Ital. *plate 15*). 1, 2, leaves × 20; 3, 4, cross sections of leaf × 20; 5, basal leaf cells × 400; 6, upper leaf cells × 400; 7, portion of leaf awn × 400; 8, 9, capsules × 20; 10, calyptra × 20; 11, cells of annulus × 100; 12, spores × 400.

PLATE CXVIII

PLATE 119. *A. Husnotiella Pringlei.* 1, plants × 5; 2, leaves × 30; 3, perichaetial leaves × 30; 4, perichaetium and base of seta × 30; 5, leaf apex × 600; 6, capsules × 20; 7, mouth of capsule × 100. (Cardot in his original description says costa is percurrent or subpercurrent but Flowers' drawings represent the condition in the Arizona plants.)

B. Husnotiella torquescens. 1, leaves × 30; 2, leaf apices × 600; 3, basal leaf cells × 600.

C. Husnotiella revoluta. 1, leaves × 30; 2, leaf apex × 600; 3, leaves of var. *Palmeri* × 30. (Drawings by Seville Flowers.)

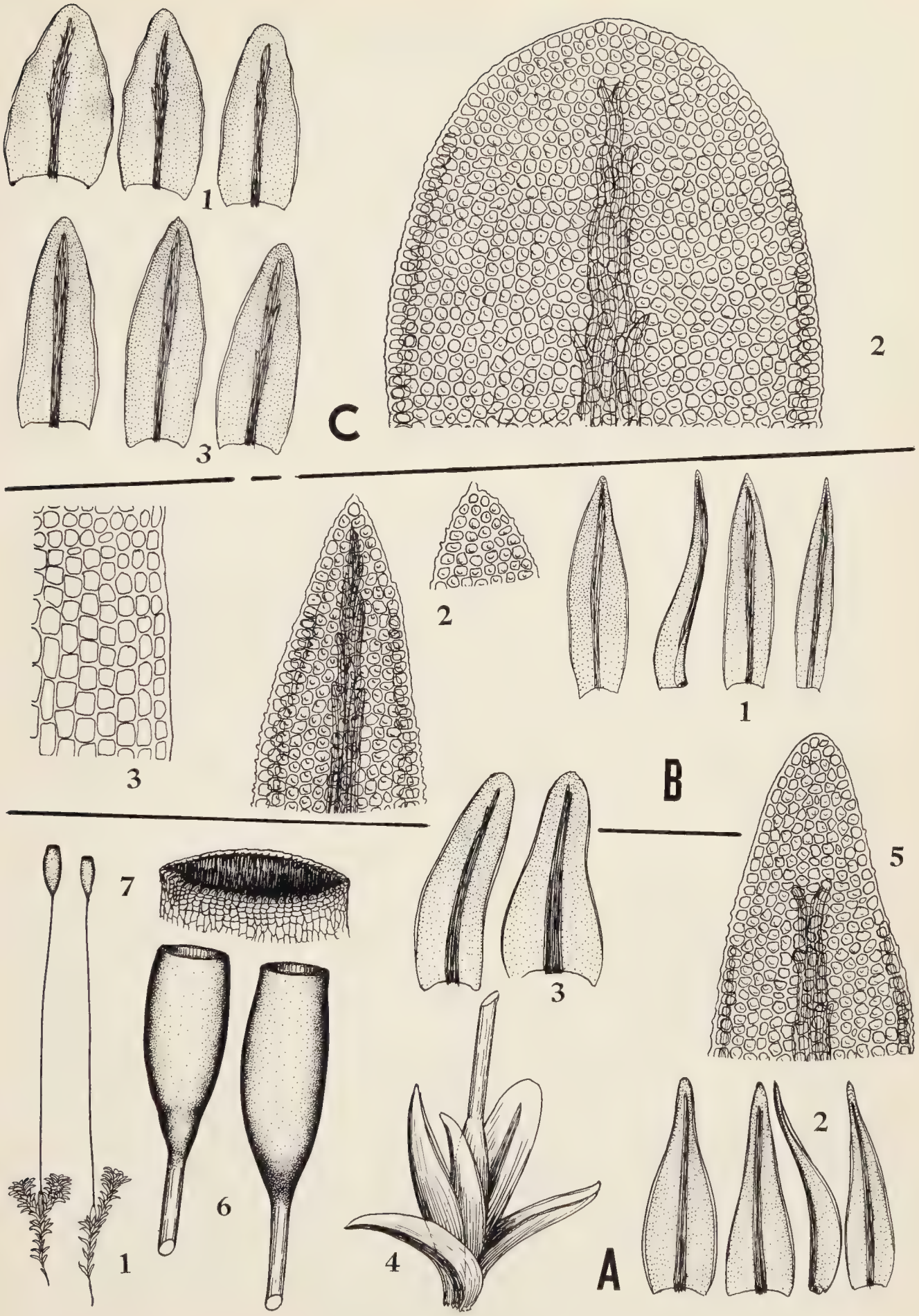
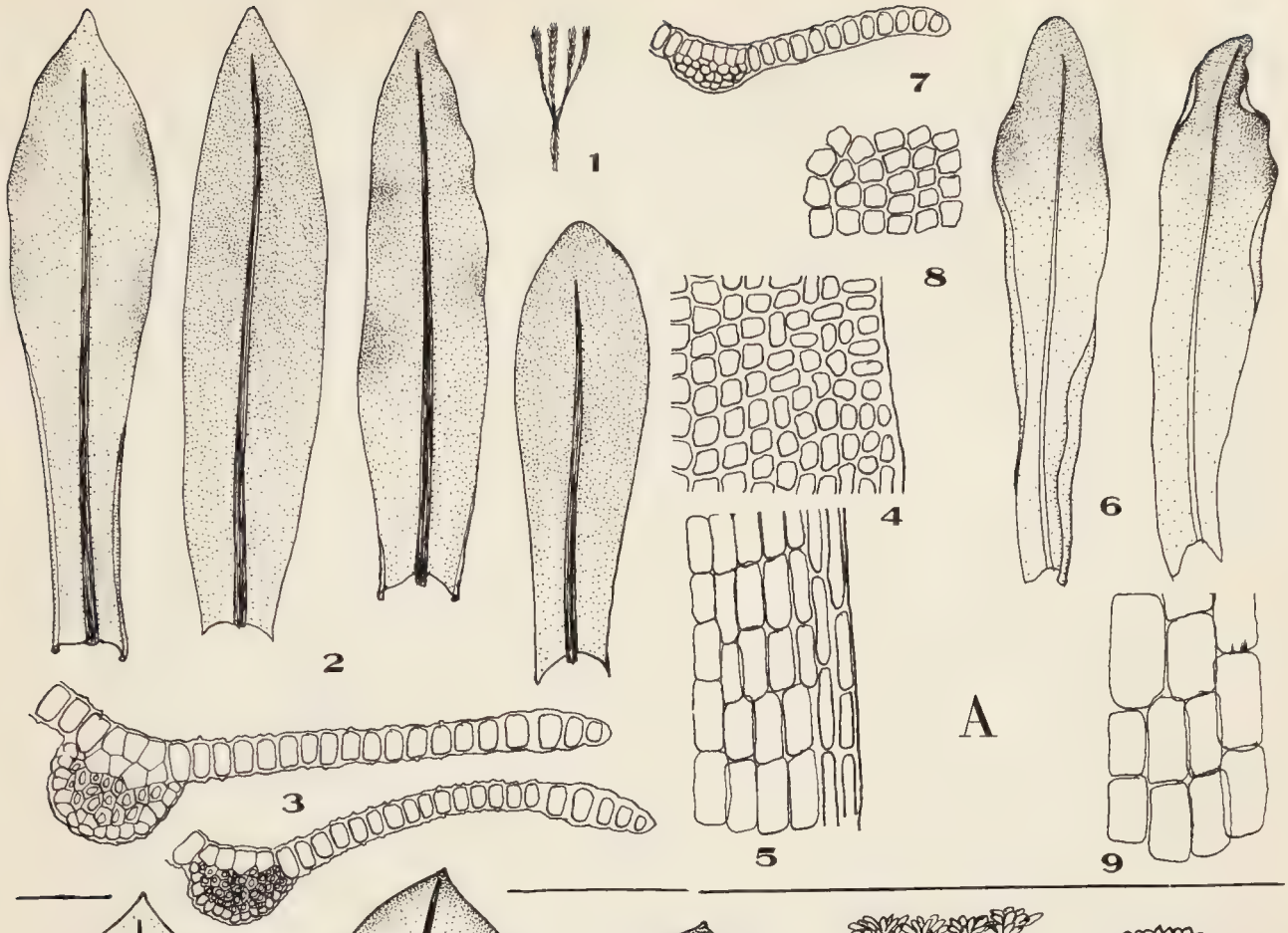


PLATE CXIX

PLATE 120. *A*. 1–5, *Merceya ligulata*, 1, habit sketch × 1; 2, leaves × 20; 3, cross sections of leaves × 300; 4, upper median and marginal cells × 300; 5, basal median and marginal cells × 300; var. *Bartramii* 6–9, 6, leaves × 20; 7, cross section of leaf × 300; 8, upper median cells × 300; 9, basal median cells × 300.

B. *Merceya latifolia*. 1, habit sketch × 1; 2, leaves × 20; 3, cross sections of leaf × 150; 4, two cross sections of leaf margins × 300; 5, upper median and marginal cells × 300; 6, basal median and marginal cells × 300; 7, cross section of stem × 150.



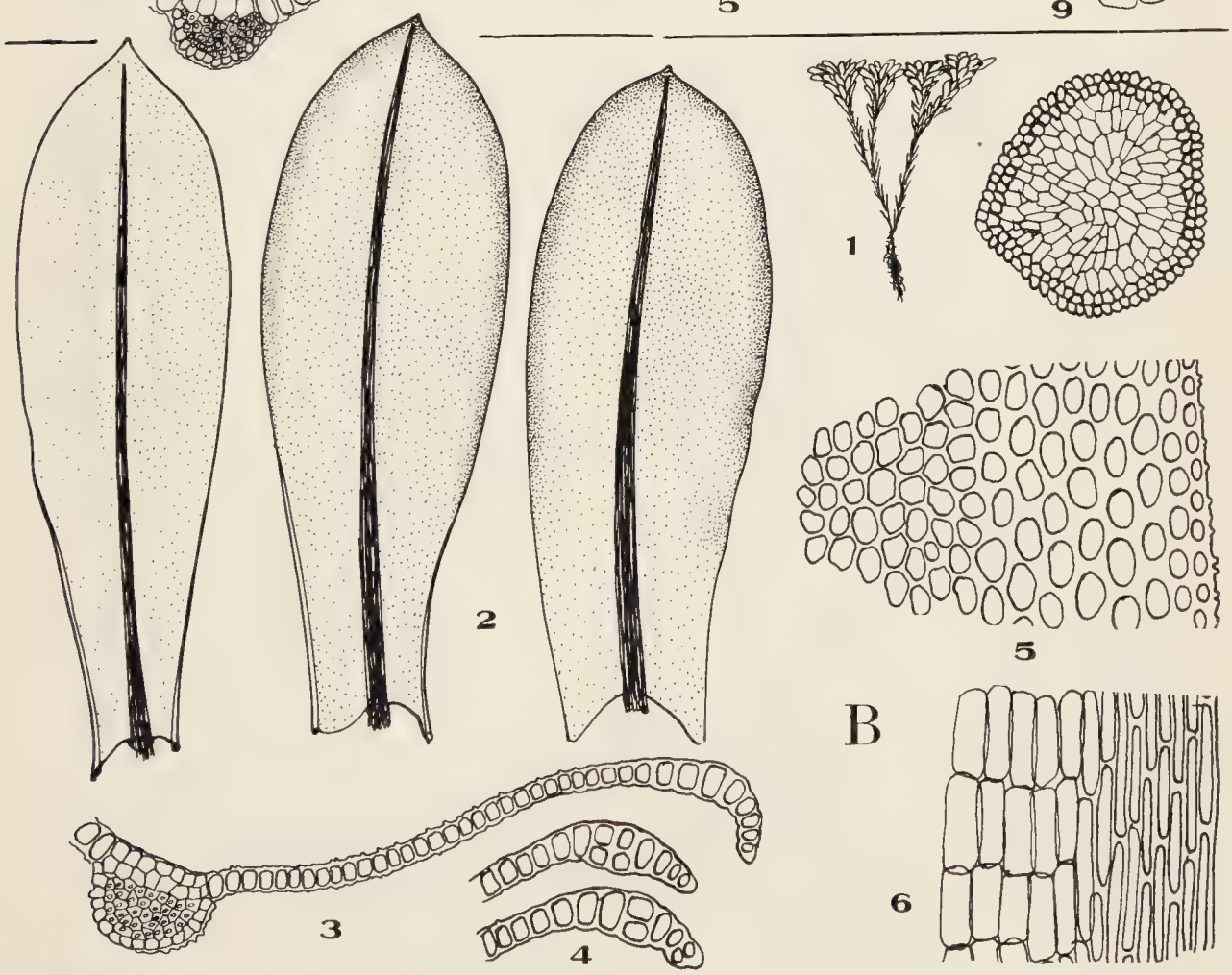
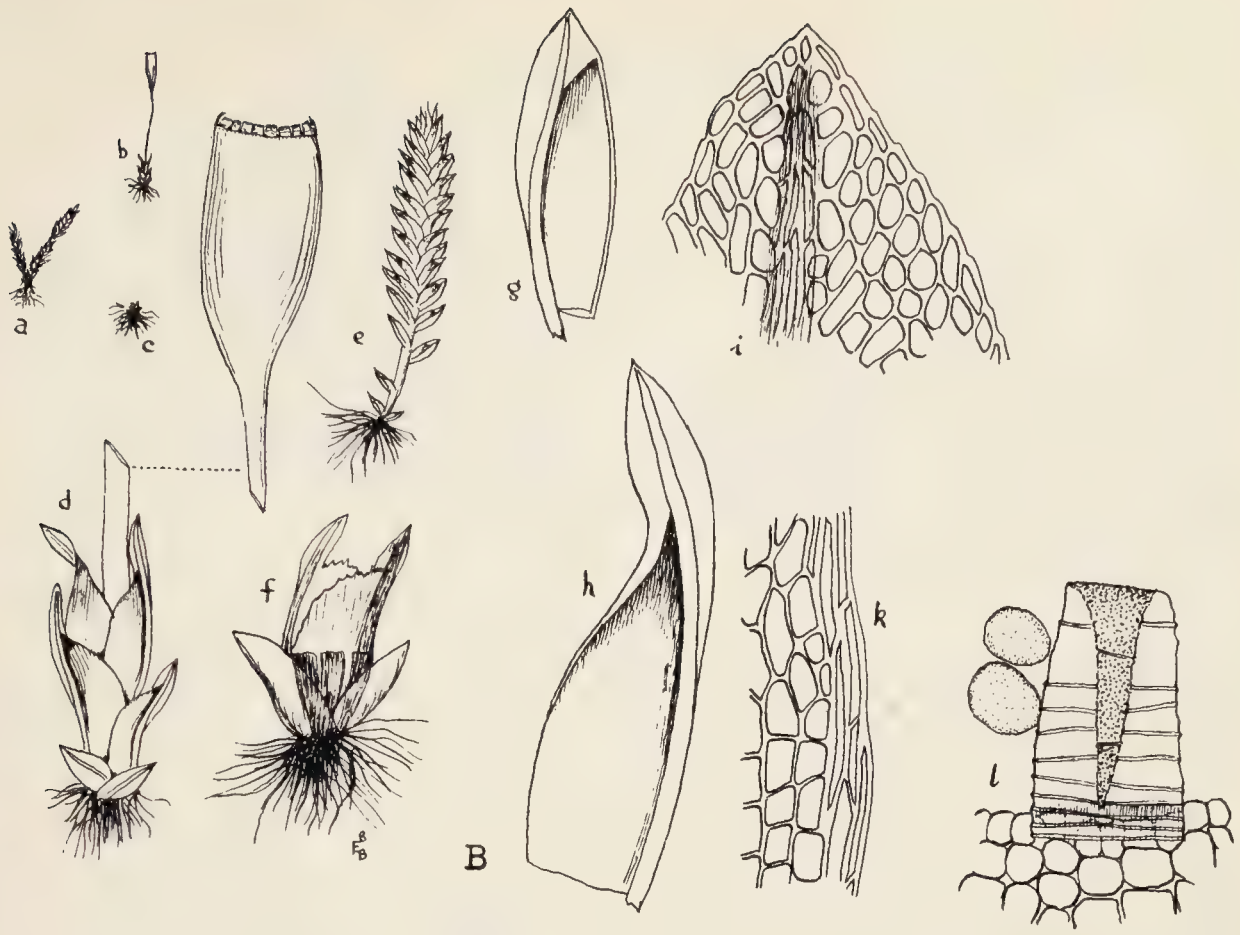


PLATE CXX

PLATE 121. *A. Syrrhopodon Gaudichaudi* (drawings by Dr. Flowers). 1, leaves from a Florida plant × 20; 2, leaves from a Brazilian plant × 20; 3, leaf apex of Florida plant × 200; 4, leaf apex of a Brazilian plant × 200; 5, leaf apex of Florida plant bearing brood bodies × 200; 6, leaf apex of Brazilian plant with brood bodies × 200; 7, upper marginal leaf cells × 200.

B. Fissidens Neoni (from Bryol. **34:** *pl. 5*). a, sterile branched stem × 3; b, fertile plant × 3; c, male plant × 3; d, fertile plant × 25; e, sterile stem × 8.7; f, male plant × 60; g, stem leaf × 60; h, perichaetial leaf × 60; i, apex of stem leaf × 350; k, basal margin of vaginant lamina × 350; l, peristome tooth from the inner side × 350.



MOENKEMEYERA NEONI Bartram, sp. nov.

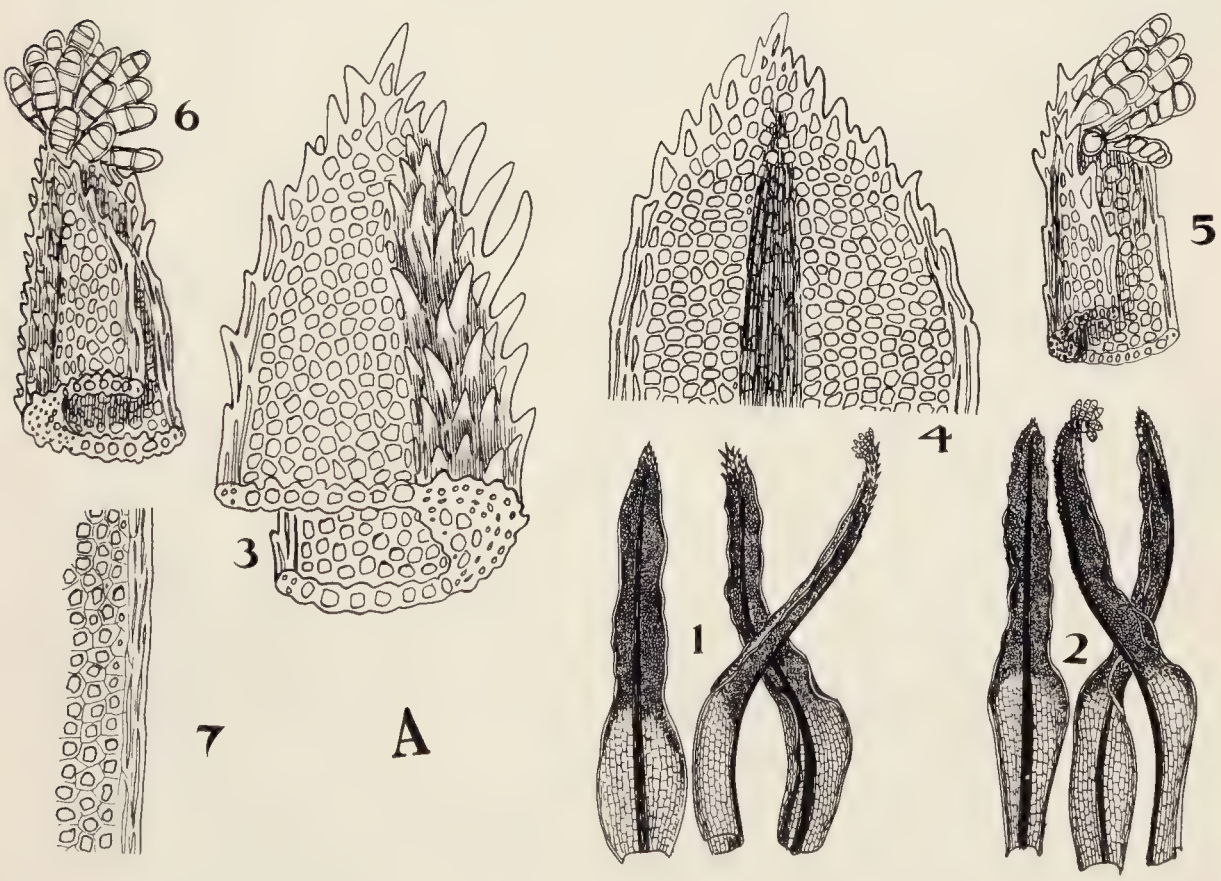
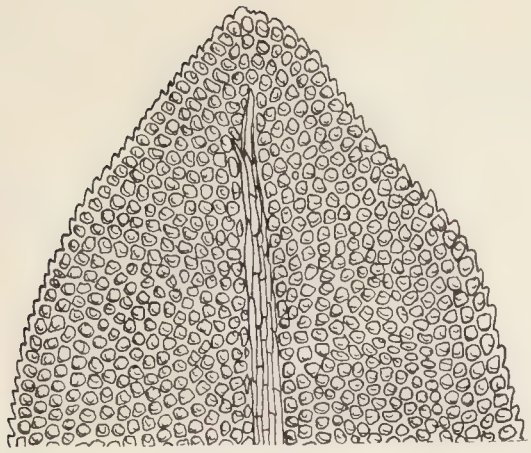
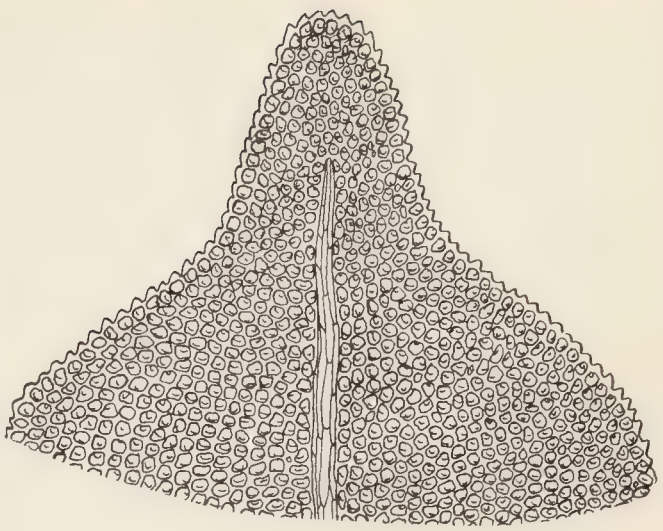


PLATE CXXI

PLATE 122. *Fissidens radicans* (by Seville Flowers). 1, plant × 8; 2, leaves × 30; 3, leaf apices × 600; 4, leaf base × 600; 5, cross section of leaf × 600; 6, capsules × 20.





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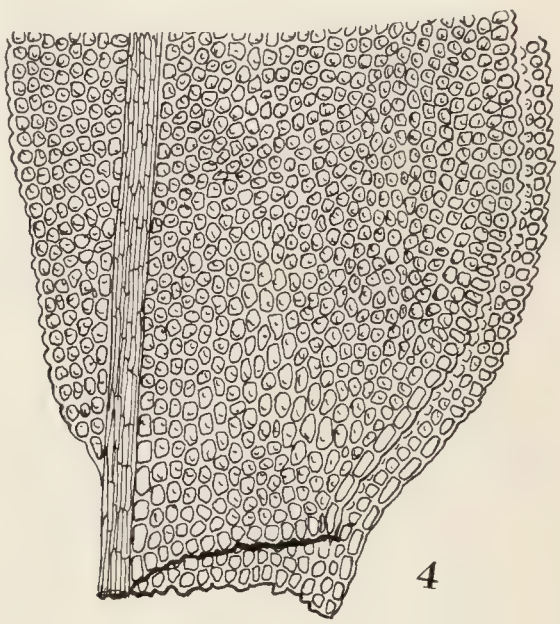

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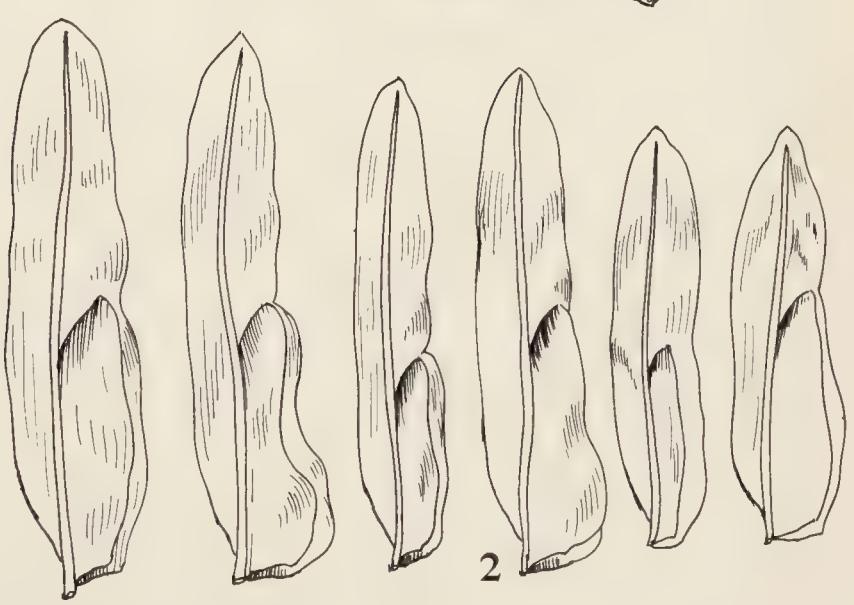


2

PLATE CXXII

PLATE 123. Figures 1–16, *Gymnostomum tenue* (From Bryol. **42**: *p. 18*). 1, whole fertile plant, showing highly differentiated perichaetial leaves × 3; 2, sterile plant × 25; 3–5, individual leaves progressively longer from base to apex of stem × 45; 6–9, cross sections of leaves from base to apex × 380; 10, leaf apex × 380; 11, cells of leaf margin about midway × 380; 12, basal leaf cells × 380; 13, perichaetium × 45; 13a, single perichaetial leaf × 45; 14, operculate capsule × 45; 15, deoperculate capsule × 45; 16, mouth of urn showing annulus and spores × 110.

Figures 17–31, *Gymnostomum calcareum* (from Bryol. **42**: *p. 20*). 17, whole fertile plant × 3; 18, whole fertile plant × 25, showing undifferentiated perichaetial leaves; 19–21, leaves from base to apex of stem × 45; 22, 23; apex of two leaves × 380; 24, cells of leaf margin about midway × 380; 25, basal leaf cells × 380; 26–29, cross sections of leaf from base to apex × 380; 30, operculate capsule × 45; 31, mouth of urn showing marginal cells and spores × 110.

GYROWEISIA TENUIS (HEDW.) SCHIMP.

GYMNOSTOMUM CALCAREUM NEES ET HORNSCH

PLATE CXXIII

PLATE 124. *A. Scleropodium apocladum.* 1, plant × 1; 2, plant × 5; 3, stem leaves × 30; 4, branch leaves × 30; 5, alar cells of stem leaf × 600; 6, alar cells of branch leaf × 600; 7, apical cells of stem leaf × 600; 8, apical cells of branch leaf × 600; 9, median leaf cells × 600; 10, capsules × 20.

B. Calliergon Wickesii. 1, portion of plant × 8; 2, stem leaves × 30; 3, branch leaves × 30; 4, lower leaves × 30; 5, alar leaf cells × 600; 6, apical cells × 600; 7, median cells × 600. (All drawings by Dr. Seville Flowers.)

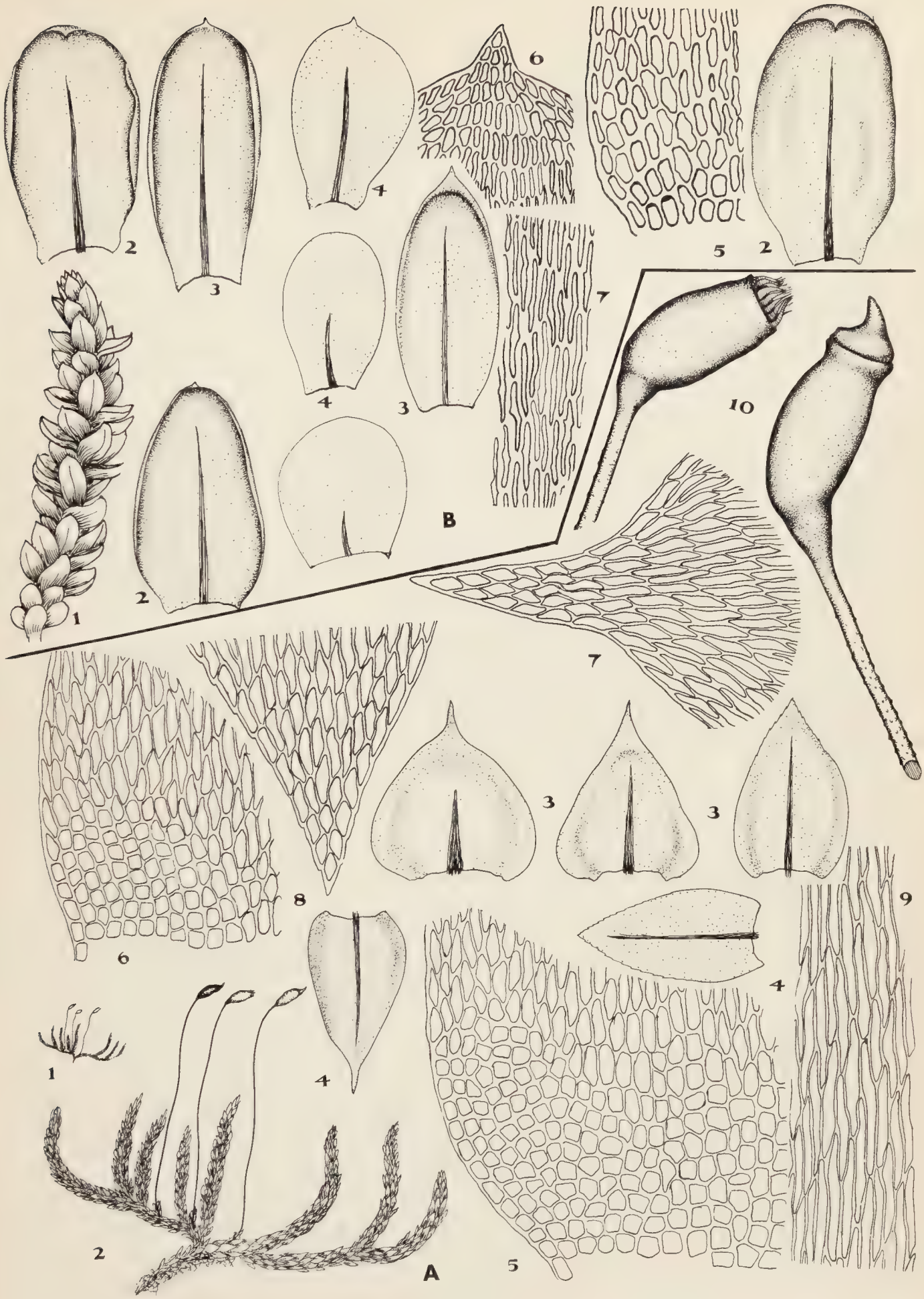


PLATE CXXIV

PLATE 125. *A. Brachythecium edentatum* (drawings from the type by R. S. Williams). 1, plant × 1; 2, capsule and operculum × 10; 3, stem leaf × 10; 4, inner perichaetial leaf × 10; 5, outer perichaetial leaf × 10; 6, basal cells of branch leaf × 200; 9, basal cells of stem leaf × 200; 7, median leaf cells × 200; 8, antheridial bud × 10; 10, part of peristome × 200.

B. Eurhynchium Brittoniae. 1, stem leaves × 20; 2, branch leaves × 20; 3, apex of stem leaf × 400; 4, apex of branch leaf × 400; 5, basal and alar cells of stem leaf × 400; 6, median cells of branch leaf × 400; 7, median cells of stem leaf × 400.

C. Scleropodium californicum. 1, stem leaves × 20; 2, branch leaves × 20; 3, apex of stem leaf × 400; 4, apex of branch leaf × 400; 5, basal and angular cells × 400; 6, median leaf cells × 400. (Drawings for *B* & *C* by Dr. Seville Flowers.)

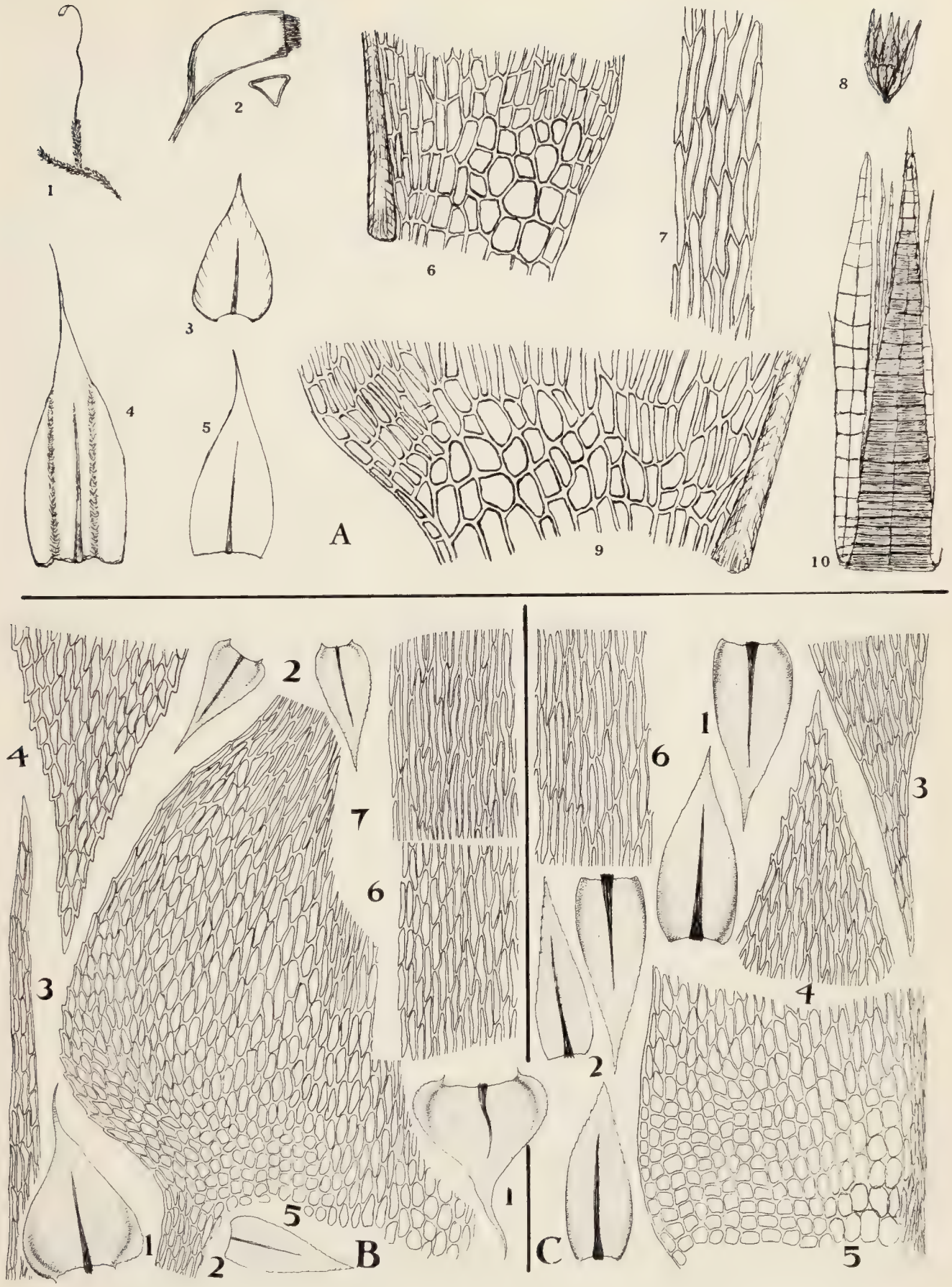


PLATE CXXV

PLATE 126. *A. Brachythecium roteanum.* 1, plant × 3; 2, stem leaves × 20; 3, branch leaves × 20; 4, leaf apices × 400; 5, basal and alar leaf cells × 400; 6, median cells × 400; 7, capsule × 13.

B. Chamberlainia biventrosa. 1, stem leaves × 20; 2, branch leaves × 20; 3, leaf apices × 400; 4, alar cells of branch leaf × 400; 5, alar cells of stem leaf × 400; 6, median leaf cells × 400.

C. Brachythecium Bolanderi. 1, plant × ⅔; 2, plant × 3; 3, stem leaves × 20; 4, branch leaves × 20; 5, leaf apices × 400; 6, alar cells of stem leaf × 400; 7, alar cells of branch leaf × 400; 8, median cells × 400; 9, deoperculate capsules × 13; 10, base of seta and perichaetium × 13; 11, capsule × 13. (Drawings by Dr. Seville Flowers.)

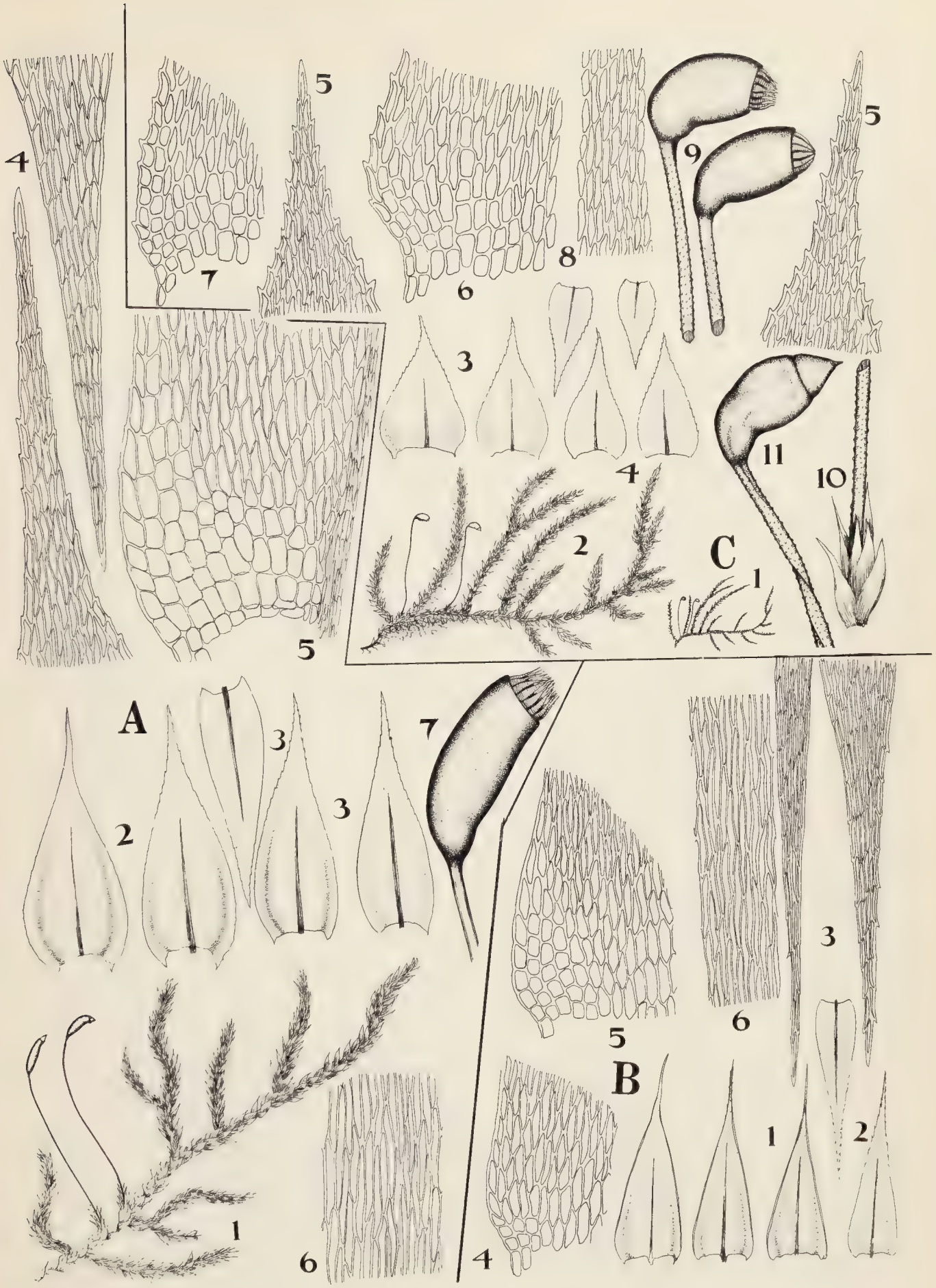
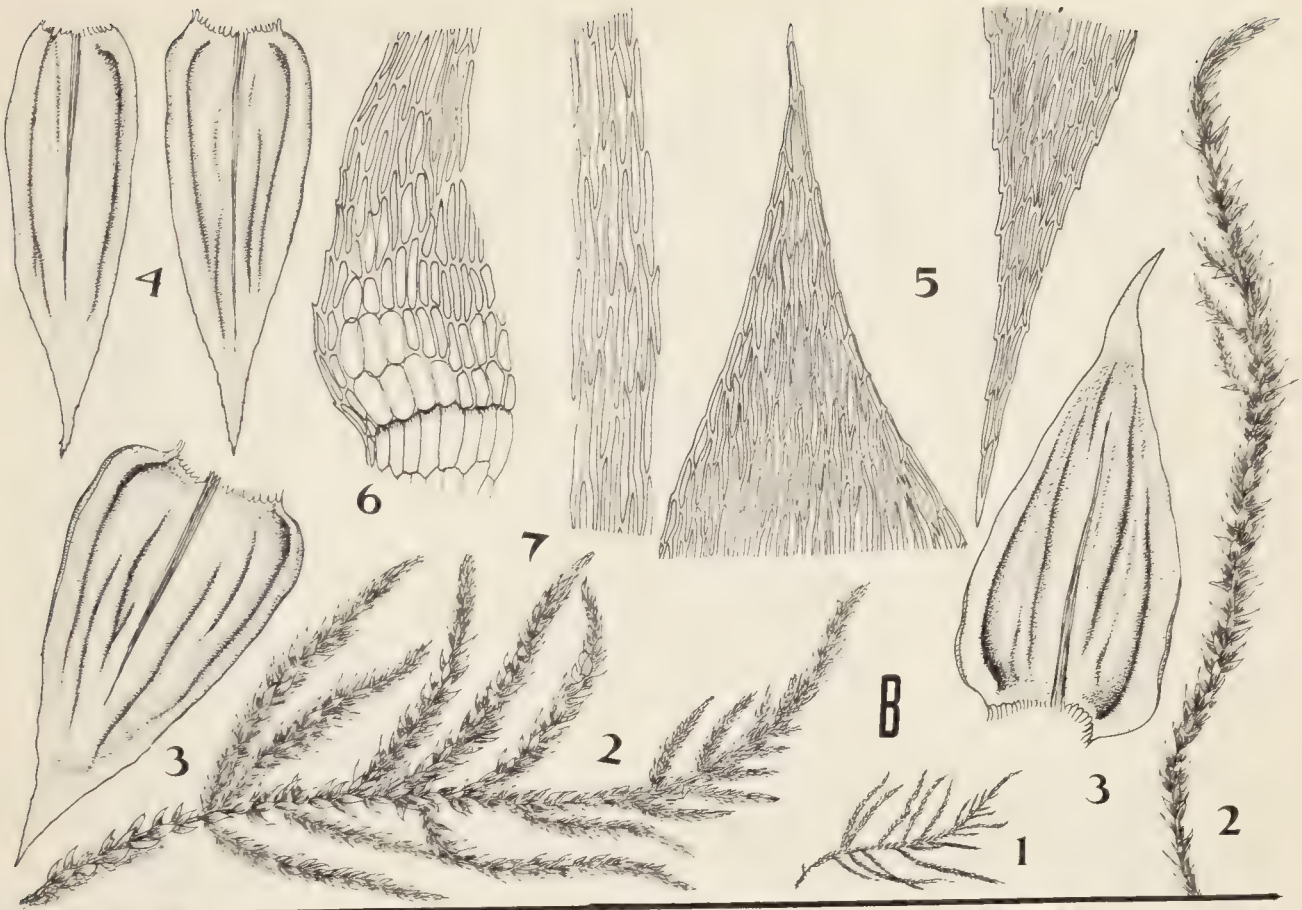


PLATE CXXVI

PLATE 127. *A. Brachythecium Wootonii.* 1, plant × ⅔; 2, plant × 3; 3, stem leaves × 20; 4, branch leaves × 20; 5, leaf apices × 400; 6, basal and alar cells × 400; 7, median cells × 400.

B. Brachythecium cavernosum. 1, plant × ⅔; 2, plant × 3; 3, stem leaves × 20; 4, branch leaves × 20; 5, leaf apices × 400; 6, alar leaf cells × 400; 7, median cells × 400. (All drawings by Dr. Seville Flowers.)



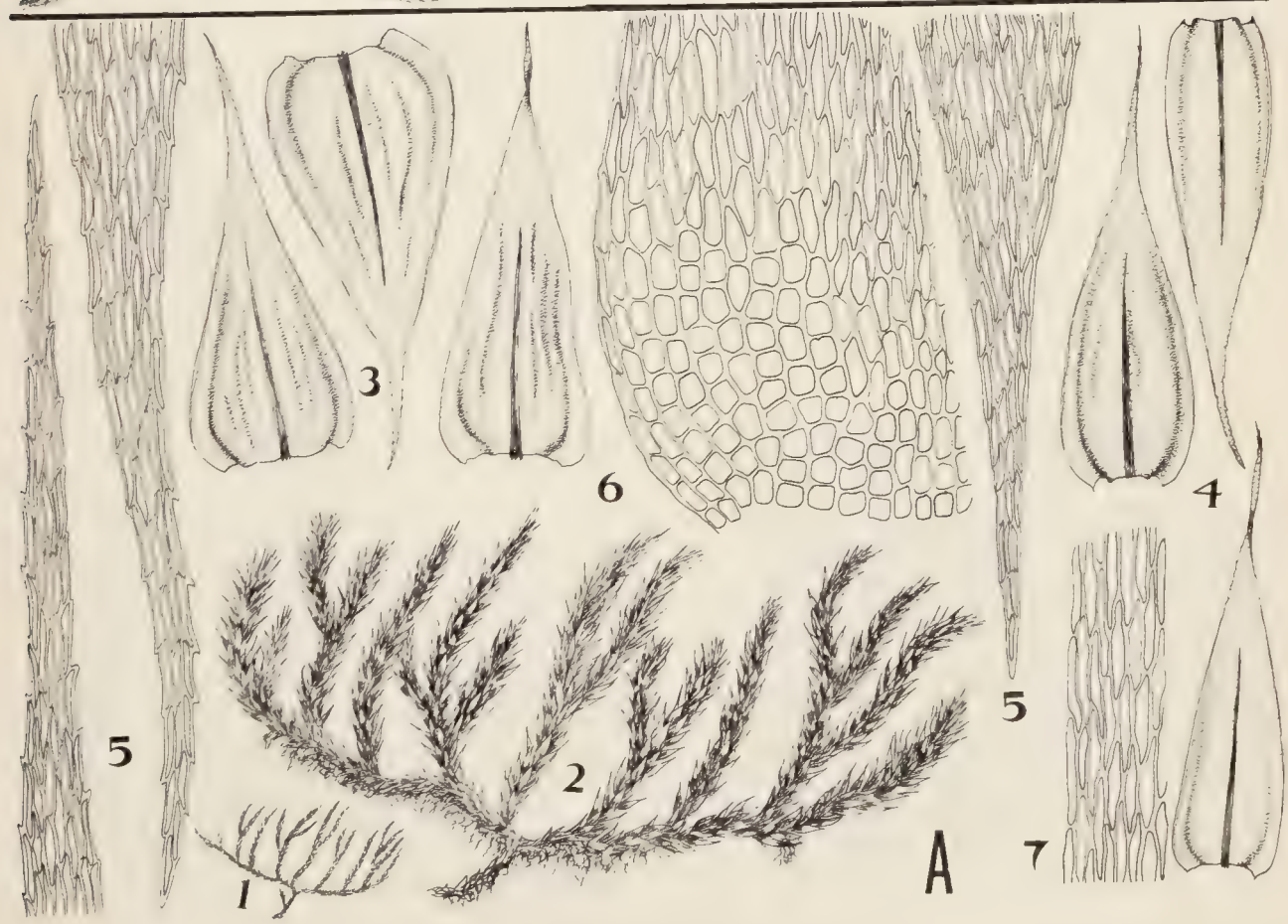


PLATE CXXVII

PLATE 128. *A. Brachythecium Leibergii.* 1, plant × ⅔; 2, plant × 3; 3, stem leaf from type × 20; 4, branch leaves from type × 20; 5, branch leaves from Allen, Mosses Cascade Mts. 105a × 20; 6, stem leaves of the same × 20; 7, leaf apices, type × 400; 8, basal and alar leaf cells × 400; 9, median cells × 400; 10, capsules × 13.

B. Bryhnia Hultenii (from type material). 1, stem leaves × 20; 2, branch leaves × 20; 3, leaf apex × 200; 4, basal marginal leaf cells above alar cells × 200; 5, median leaf cells × 200. (All drawings by Dr. Seville Flowers.)

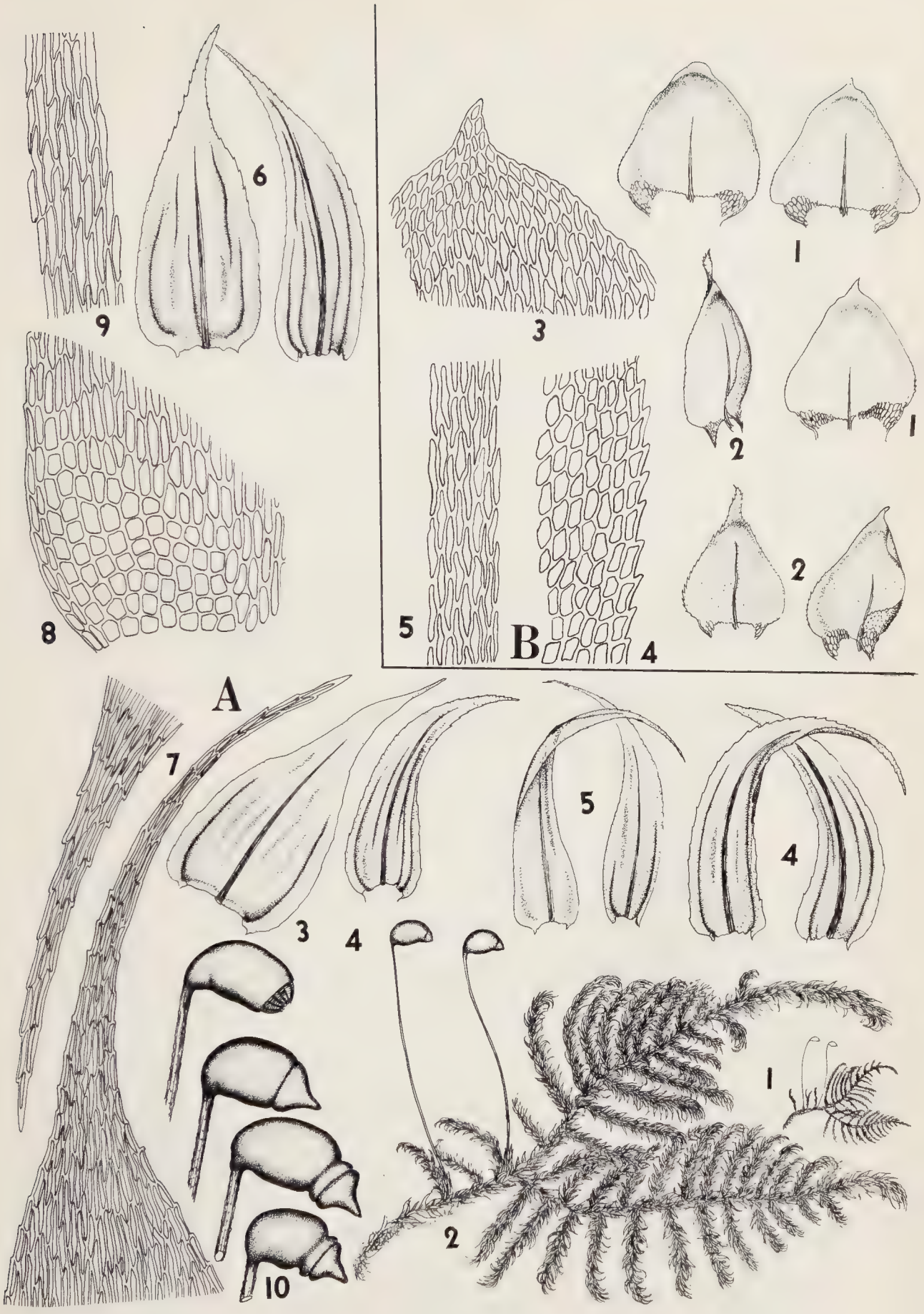
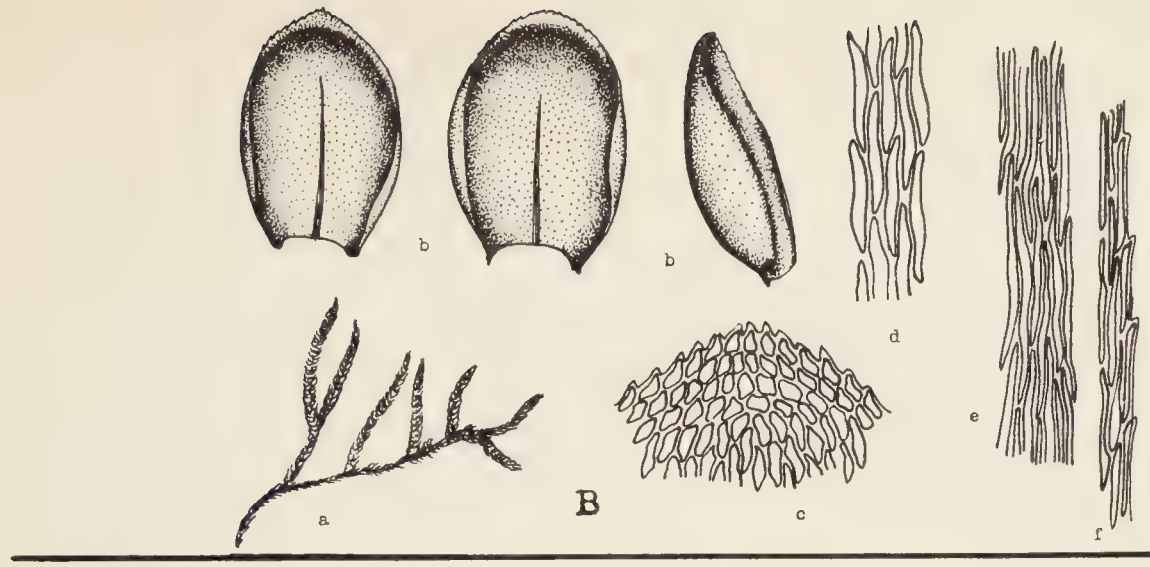
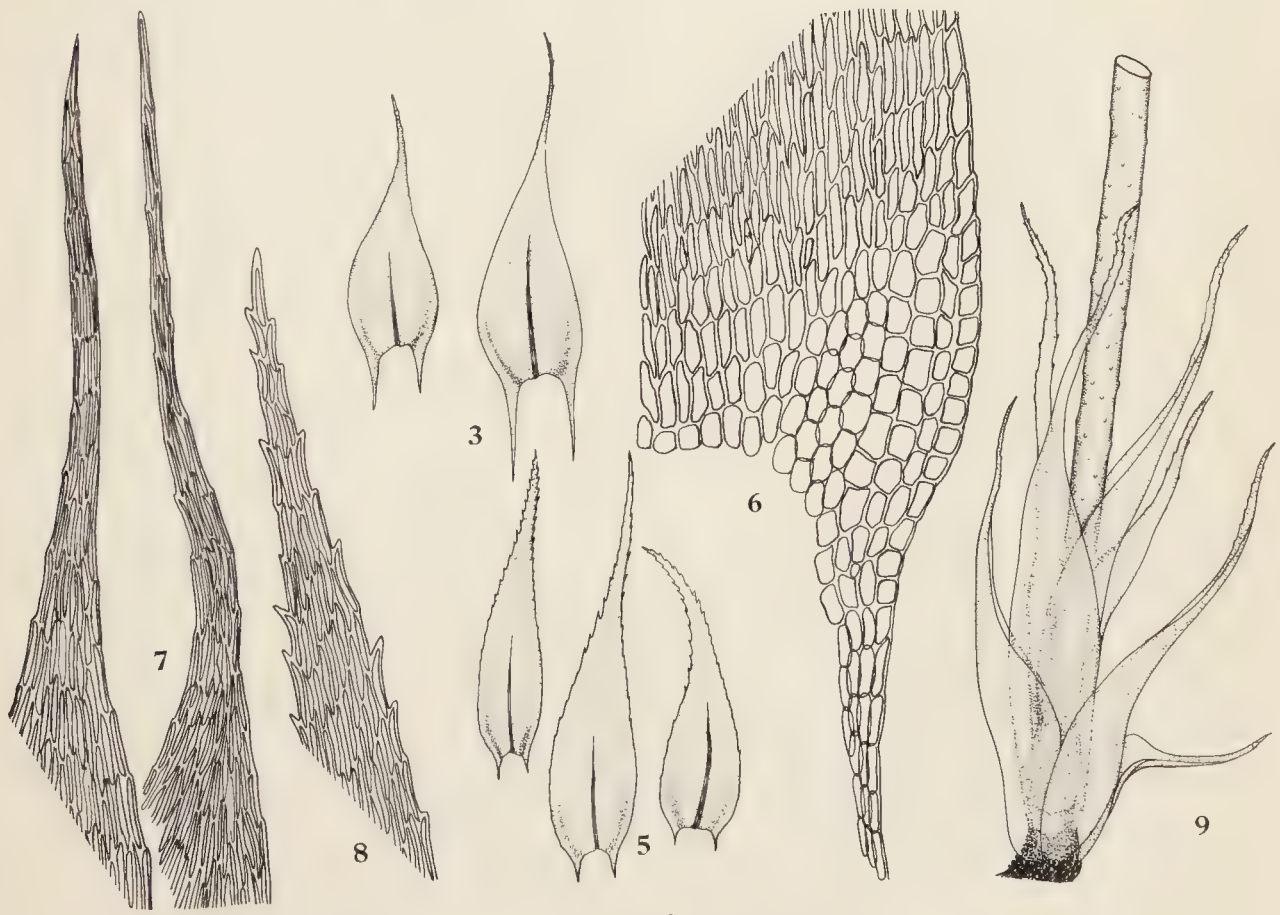


PLATE CXXVIII

PLATE 129. Lower portion. *Brachythecium Holzingeri* (drawings by Dr. Seville Flowers). 1, plant × 1.3; 2, antheridial bud × 13; 3, stem leaves × 20; 4, branch leaves × 20; 5, upper branch leaves × 20; 6, base of stem leaf × 200; 7, apices of stem leaves × 200; 8, apex of branch leaf × 200; 9, perichaetial leaves and base of seta × 20; 10, capsule × 13.

B. Hygrohypnum Nicholsii (from Bryol. **38:** *pl. 2*). a, plant × 2; b, leaves × 30; c, leaf apex × 150; d, upper leaf cells × 150; e, median cells × 150; f, lower margin × 150.





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